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United States
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Potentials for Substituting Farmers' Use of Futures and Options for Farm Programs

Richard G. Heifner
Bruce H. Wright

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Potentials for Substituting Farmers' Use of Futures and Options for Farm Programs. By Richard G. Heifner and Bruce H. Wright. Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report Number 628.

Abstract

By using commodity futures, options, or cash forward contracts, farmers can broaden their pricing alternatives and partly protect themselves against price declines within a given year, but they cannot effectively stabilize their incomes across years. Each of these types of contracts sets a price or a price limit for a commodity to be delivered at a later date; futures and options contracts are standardized and traded on exchanges; a commodity option gives the holder the right to buy or sell a futures contract at a specified price during a designated time interval. Government programs to expand use of such contracts by farmers generally would not raise or stabilize market prices or farmers' incomes unless subsidies were involved. Such subsidies would be difficult to administer and offer few advantages over conventional farm programs.

Keywords: Cash forward contracts, deficiency payments, farm programs, futures, options, price support

Preface

This report is part of the U.S. Department of Agriculture's (USDA) response to Section 1742 of the Food Security Act of 1985. Section 1742 calls for USDA to study the manner in which farmers might use futures and options markets, the extent of the price stability and income protection that producers might expect to receive from such participation, and the Federal budgetary impact of such participation. This report describes part of the analyses underlying the study. Results from the study are summarized in USDA's report, Futures, Options, and Farm Programs: Report to Congress on a Study Mandated by the Food Security Act of 1985 (AGES 9003).

Acknowledgments

The authors would like to thank Linda L. Hatcher of the Economics Management Staff for editorial services and Nedra C. Williams of the Economic Research Service for secretarial assistance.

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Summary

By using commodity futures, options, or cash forward contracts, farmers can broaden their pricing alternatives and partly protect themselves against price declines within a given year, but they cannot effectively stabilize their incomes across years. Each of these types of contracts sets a price or a price limit for a commodity to be delivered at a later date; futures and options contracts are standardized and traded on exchanges; a commodity option gives the holder the right to buy or sell a futures contract at a specified price during a designated time interval. Government programs to expand use of such contracts by farmers generally would not raise or stabilize market prices or farmers' incomes unless subsidies were involved. Such subsidies would be difficult to administer and offer few advantages over conventional farm programs.

This report addresses questions raised in Section 1742 of the Food Security Act of 1985, which calls for the U.S. Department of Agriculture (USDA) to conduct a study to determine how farmers might use futures and options markets, the price stability and income protection attainable through such use, and the effect on the Federal budget of such participation. This is one of three technical studies underlying the main report on "Futures, Options, and Farm Programs." This study examines (1) the benefits to farmers from using existing forward pricing institutions and (2) possible Government actions to expand use of agricultural forward markets and to partly substitute such use for traditional price support programs. The study supports the following conclusions.

Farm Price and Income Levels. Farmers can expand their pricing alternatives, but as a group they cannot raise the average prices they receive, by forward pricing with futures, options, or cash forward contracts. Futures and options markets provide farmers information about traders' price expectations and opportunities to price forward (that is, to set a price or a minimum price ahead of delivery). Farmers can use the price information generated in futures and options markets to make production and storage decisions without trading on the market themselves. But to price forward they must either trade futures or options or enter cash forward contracts with local buyers. About 20-30 percent of U.S. farmers typically price their crops before delivery using cash forward contracts with local buyers, while less than 10 percent directly use futures. Forward pricing has been heaviest in the Midwest, where 25-50 percent of corn and soybean growers have used cash forward contracts during typical years. Crop growers' use of agricultural options remains relatively small.

By pricing forward, farmers can reduce revenue risks in a production or marketing operation (hedging), seek profits from price changes (speculation), or combine the two (selective hedging). The forward pricing contracts available to farmers can be categorized into those that fix the price (futures and most cash

contracts with local buyers) and those that establish a price limit (options and minimum-price contracts with local buyers).

Forward pricing by farmers is costless to the Government, but it is not likely to raise farmers' average prices or incomes as can deficiency payments and Government loans at prices above market-clearing levels. Deficiency payments are payments from the Government to a farmer equal to the difference between the target price and the greater of the market price or the loan rate. Farmers would have received slightly lower prices on average from 1960 to 1988 from selling corn, soybeans, and cotton at planting than from selling at harvest, but they would have received higher prices for winter wheat. However, these historical differences cannot be expected to continue because competition among speculators tends to make forward prices at planting time equal to harvest prices on the average. As a group, farmers are probably no better at price forecasting than other small traders, and small traders lose money on average to commercial traders in the futures markets. Forward pricing may enable farmers to safely borrow more money and/or shift resources into expanded production. However, if many farmers expand production due to reduced risk, prices may decline. When all things are considered, forward pricing is not likely to change farmers' average incomes by very much, although some of the more skillful or lucky may gain.

Farmers' Risks. Farmers can reduce risks from price declines within a given year, but they can gain little or no interyear income stability by pricing their crops before delivery with futures, options, or cash forward contracts. Forward pricing with futures at planting can reduce uncertainty about current-year revenues from corn, soybean, wheat, and cotton growing by up to 40 percent. Forward pricing routinely each year reduces variability in net revenue across years by 0-20 percent. Yield variability contributes about as much as price variability to farmers' revenue risks, and neither forward pricing nor Government price support programs protect farmers against low yields. To minimize risks most farmers should sell futures or enter cash forward contracts for no more than 50-80 percent of their prospective crops at planting.

Commodity options widen farmers' pricing alternatives and offer price protection for the current year's crop similar to that provided by Government loans and deficiency payments. The holder of a put option can benefit from price increases and avoid margin calls. A margin call is a request from a brokerage firm to a customer or from an exchange clearinghouse to a clearing-house member for additional margin to cover the customer's futures position after a price change that is unfavorable to the customer. If the crop fails, the option holder has no obligation to buy back the contract at a possibly higher price. Option buyers must pay a nonrefundable premium for the price guarantees embodied in option contracts.

Although put options offer the farmer broader pricing alternatives than futures, puts provide a lower assured net price

after the option premiums are subtracted. The chance to gain from a price increase compensates the put option holder for accepting a lower assured net price.

Government Costs. Replacing Government loans or deficiency payments with programs to expand farmers' use of futures or options contracts would not reduce Government costs unless support levels were lowered. Farmers' incomes could be supported by subsidizing farmers' use of futures or options contracts. The Government could stabilize farmers' incomes by making larger payments during years with low prices. Since futures-options subsidies would not remove products from the market or greatly affect stockcarrying, the effects of such subsidies would be similar to using deficiency payments. Such payments would cost taxpayers more than supply controls to raise farmers' incomes any given amount but consumers would be expected to benefit.

One of the first issues that arises in the design of a futures-options subsidy program concerns the types of contracts to be included: put options, short futures positions, call options, cash forward contracts, or other types of contracts. Farmers' specific needs would be served better by a wide choice of contracts, but administration would be more complicated. Other issues include whether to encourage contracting early in the growing season and whether to allow farmers to roll the positions that they hold over to contracts with later expiration dates.

Programs involving futures-options subsidies would be difficult to administer and difficult for some farmers to use because of the complexities of futures and options trading. Any such program would need to have a strong educational component.

Government Cost Uncertainties. Uncertainties regarding the farm program budget might be reduced by Commodity Credit Corporation hedging or by replacing deficiency payments or loan programs with subsidies for farmer hedging. Very large increases in private holding of futures or options positions would be required. The ability of the futures and options markets to absorb these large positions and the magnitude of the risk premiums that traders would require is unknown.

Potentials for Substituting Farmers' Use of Futures and Options for Farm Programs

Richard G. Heifner
Bruce H. Wright*

Introduction

To what extent can farmers' use of commodity futures and options markets and cash forward contracts substitute for farm programs? Is it possible to design a new type of farm program that operates through or in conjunction with futures and options markets and that offers significant advantages over existing programs? These are challenging questions to those familiar with the shortcomings of existing programs and the pricing and risk-shifting capabilities of futures and options markets. A little probing shows that expanded farmer use of futures and options markets offers no quick and easy solutions to farmers' price and income problems. However, farm programs may have taken over some functions that can be performed better in the marketplace. This study seeks to identify the possibilities and quantify the effects, where possible, of policy alternatives that involve greater use of forward markets.

Although futures trading and price supports have coexisted since the 1930's, the two institutions have serious incompatibilities. Futures trading thrives on price uncertainty; it generally declines in volume as price supports are raised and become more effective in creating a price floor. Commodity options trading can be expected to be similar to futures trading in this respect. The relationships between Government programs and forward markets have received relatively little attention in the development of farm policies. This study examines these relationships and explores ways to integrate prospective programs with the forward pricing institutions of the market.

A pilot program being conducted by the U.S. Department of Agriculture (USDA) under the provisions of the Food Security Act of 1985 provides a limited test of a specific futures-options program (see "Glossary"). However, a pilot program can tell us little about the effects of a nationwide program or the differences in effects between alternative programs. Such

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information is brought together in this study by drawing from previous studies, identifying possibilities for alternative types of futures-options programs, measuring the relevant economic relationships, and using these relationships to explore the outcomes of possible programs.

Background

The case for forward pricing farm products was articulated by D. G. Johnson in 1947. Johnson emphasized that forward pricing can improve the efficiency of resource use by reducing price and income uncertainty. He was not optimistic that private commodity markets could be reformed to provide the needed reduction in uncertainty, and suggested that Government storage and supplementary payments may be necessary.

Other authors have argued that forward pricing is accomplished better through commercial trading than through Government actions. For example, Newbery and Stiglitz (1981, p. 445) stated the following:

In short, although the market does not necessarily provide an efficient allocation of resources, we believe that the gains to be had from a commodity price stabilization program are likely to be small, and that most of the benefits in risk reduction may be had by improving the workings of the market, for example, by making futures markets more readily accessible (directly and indirectly) to small producers.

A farmer who holds put options covering products being produced or held in storage faces risks similar to those faced by a farmer who is eligible for price support. Both farmers are assured of a minimum price and both can take advantage of a market price above the minimum if it should occur. Thus, Gardner (1981, p. 109), writing before the reopening of options trading in agricultural commodities, pointed out that:

A commodity-options market that is functioning well would be an excellent substitute for the income-stabilization features of current farm programs for grains, rice, and cotton. In fact, it would be better, in that each farmer could choose the degree of price insurance that he wanted by purchasing a put option at the appropriate guaranteed price.

Gardner went on to suggest that the Commodity Credit Corporation (CCC) itself could be a writer of put options if the appropriate contracts were not traded on exchanges.

Both price supports and futures and options markets provide known forward prices or minimum prices to guide farmers' production and

marketing decisions. Use of either can protect a farmer from unexpectedly low returns. However, futures or options trading without subsidies does not transfer income to farmers as do price supports, and price supports do not help or even allow markets to clear as do futures and options trading. Thus, the two types of institutions are imperfect substitutes for each other.

Objectives

The overall objective of the study is to evaluate possibilities for replacing or supplementing existing farm programs with expanded direct or indirect use of futures and options markets by farmers. Within this overall objective, subordinate objectives are to:

1. Assess the usefulness of commodity futures, options, and cash forward contracts to farmers.
2. Identify and evaluate the feasibility of new types of farm commodity programs or changes in existing programs that involve greater reliance on forward markets for pricing and risk shifting.
3. Assess the Federal budgetary implications of alternative programs, including effects on the level and variability of expenditures.

Plan of Analysis

Pursuit of these objectives has included the following activities:

1. Assembling relevant findings from previous studies of farm programs and farmers' use of futures, options, and cash contracts.
2. Supplementing and extending previous work with additional data and statistical analysis where needed.
3. Identifying possible program alternatives and assessing their probable effects.

Forward Pricing by Farmers

Futures and options trading contributes to economic productivity by generating information about expected prices on future dates and by redistributing price risks. These markets facilitate forward pricing, which occurs when a seller and a buyer agree on a price for a trade to occur in the future. Farmers can expand their pricing alternatives, but as a group, they cannot raise the average prices they receive by forward pricing with futures, options, or cash forward contracts. Forward pricing generally reduces uncertainties about current-year revenues but does not effectively reduce uncertainties about future years' revenues.

Each different type of forward contract has advantages and disadvantages.

Rationale for Forward Pricing

Farmers are exposed to commodity price variation because they own commodities or resources committed to producing commodities that will be sold in the future. Forward pricing modifies this price exposure. Those who can successfully forecast price movements can profit directly by buying or selling when they expect prices to rise or fall. Even those producers, merchants, or processors who cannot forecast price changes may benefit from pricing forward through reduced revenue uncertainty.

In crop production, as with other business enterprises, resources must be committed well before the quantity and value of output is known. The lag between resource commitment and output ranges from a few months for inputs like chemicals, fertilizer, and fuel to years for investments in land, machines, and farming skills. These lags, combined with unpredictable variations in price and yield, subject farmers to large uncertainties about their gross revenues and their net incomes.

Producers generally are more exposed to price variations than investors because production requires concentrating assets in one or a few enterprises to gain the advantages of specialization. The risks associated with specialization can be spread by such arrangements as share renting, partnerships, and private corporations with share holding. Forward pricing serves a similar function by shifting commodity price risks to other traders who have offsetting risks or for whom the risks are less burdensome.

Farmers can use forward markets either to increase or decrease their exposure to price variation. At one extreme is pure speculation, done solely to gain from anticipating price change. Pure speculation is independent from the farm business and not analyzed in this report. At the other extreme are pure hedgers, who hold neutral views about the direction of price movements and price forward solely to shift risk. A combination of hedging and speculative motives underlie most of the forward pricing done by farmers and other businesses. When they anticipate price declines, farmers tend to sell short more than they would otherwise. When they expect price increases, their forward selling is less.

Types of Forward Contracts

A contract is an agreement between two parties to exchange goods, services, or other assets for money or something else of value. This section deals with private contracting--contracts between two individuals, particularly farmers and their buyers. This contrasts with social contracts, which are written or unwritten commitments between a government and its citizens. A price support program is a form of social contract.

Commodity contracts call for either spot or deferred delivery. Spot delivery is immediate delivery or delivery within a short time period as understood in the trade--typically 1 day, 10 days, or during the current month for agricultural commodities. Deferred delivery includes everything else. To forward price is to set a specific price or a minimum or maximum price for deferred delivery. This contrasts with deferred pricing, which involves agreeing to set a price by formula at a later date. Delayed pricing--a form of deferred pricing that involves immediate delivery--is sometimes used in contracts between elevators and farmers to let the elevator assume ownership of the farmer's grain and move it into marketing channels while allowing the farmer to postpone setting the price.

A forward contract sets a price or establishes rules for setting a price and specifies the quantity, grade or quality, and time and place of delivery. Important differences in forward contracts pertain to whether the contract is traded on or off an exchange and to the method for setting the price.

Exchange-Traded Contracts Versus Cash Forward Contracts

Commodity futures and options contracts are standardized forward contracts that are traded on organized exchanges. For example, all December corn futures contracts traded at the Chicago Board of Trade are identical in size and grade, time, and place of delivery requirements. Price is the only contract term left to be determined at trading time.

Telser (1981) explained the existence of organized futures markets, as contrasted to forward contracting in general: "An organized futures market facilitates trade among strangers." Exchanges enforce trading rules and stand behind each contract through their clearinghouses. The standardized contracts and clearinghouse guarantees attract speculators to futures markets. Speculators provide liquidity--ability of the market to readily absorb trades without price distortions. High liquidity and absence of default risk make futures and options contracts particularly useful to merchants, processors, and producers for taking temporary positions to protect against price changes.

Most futures contracts are offset by opposite trades before delivery is required. Delivery is uncommon because the time, place, and grade specifications of futures contracts generally differ from those needed for merchandising particular lots of commodities.

Forward contracts entered outside of an exchange are called cash forward contracts. Virtually all cash forward contracts are fulfilled by delivery; quantity, grade, time, and place of delivery are set to fit the seller's and buyer's specific needs. Compliance with contract terms is assured by mutual trust between the contracting parties and regulated under State laws. Merchants and processors who buy forward from farmers typically cover these commitments by selling forward to other buyers, selling futures contracts, or entering options contracts.

Method for Specifying Price

Forward contracts can be categorized according to the method used for specifying the price:

Fixed-price Contracts. The price is set as the contract is entered. These include futures contracts and most cash forward contracts.

Option or Minimum- (Maximum-) Price Contracts. One party, called the writer or grantor in options trading, guarantees either a minimum or maximum price during a specified time interval. The other party, the option holder, pays the writer a premium for the privilege, without obligation, to either buy or sell at the guaranteed (strike) price. The options traded on commodity exchanges grant rights to buy or sell futures contracts. A call option carries a right to buy and a put option a right to sell at the strike price. When the strike price equals the current market price for the futures, the option contract is said to be "at the money." If the strike price exceeds the market price for a put option or is less than the market price for a call option, the option contract is "in the money." If the strike price is less than the market price for a put option or exceeds the market price for a call option, the option is "out of the money."

Off-exchange trading of commodity options is prohibited by the Commodity Futures Trading Commission Act. However, buyers of farm products are allowed to offer minimum-price contracts that guarantee farmers a minimum price if the farmer commits to deliver what was sold to the buyer either at the minimum price or a higher price based upon market conditions.

Formula Pricing. The price is set relative to a base price to be observed during a designated future time interval. Examples include pricing meats based upon USDA Market News price quotations, pricing eggs based upon Urner-Barry reports, and "booking the basis" for grain and "call pricing" of cotton, both of which involve setting the price relative to a futures price quotation to be observed later. The contract must specify the time intervals for setting the price and for delivery and indicate whether the seller or buyer has the right to choose the specific time at which to apply the formula.

Comparisons Between Different Types of Contracts

The major differences from the farmer's standpoint between various types of private and Government instruments for forward pricing farm products are summarized in table 1.1/ None of the private contracts raise the average price that the farmer can

1/ Excluded from the table are contracts for performing production services, such as growing crops or feeding livestock, which can also limit farmers' exposure to the risk of commodity price changes.

expect to receive. Average prices over a period of years can be raised only by Government programs that reduce quantities reaching consumers or increase consumer demand.

Holding put options, entering minimum-price cash forward contracts, and price supports all give the farmer a distribution of revenues that is skewed to the right. Compared with selling

Table 1--Effects of different forward pricing instruments on farmers

Effect	Instrument				
	Sell futures	Buy put option	Fixed-price cash sale	Minimum-price cash sale	Government price support loan
May offer above-market price	No	No	No	No	Yes
Skews price distribution to right	No	Yes	No	Yes	Yes
Provides range of choices	Some <u>1/</u>	Wide <u>2/</u>	Varies	Varies	No <u>3/</u>
Allows contract size to vary	No <u>4/</u>	No	Yes	Yes	Yes
Assures competitive price	Yes	Yes	Varies	Varies	--
Covers larger than expected output	No	No	No	No	Yes
Avoids obligation if crop fails	No	Yes	No	Yes <u>5/</u>	Yes
Avoids basis risk	No	No	Yes	Yes	Yes
Avoids margin calls	No	Yes	Yes	Yes	Yes
Avoids risk of buyer default	Yes	Yes	Varies	Varies	Yes

-- = Not applicable.

1/ Choice of delivery dates.

2/ Choice of strike prices and delivery dates.

3/ Only one local support price is available, but loan repayments can vary.

4/ Two different sized contracts are available for some commodities.

5/ The farmer may have to pay premiums and associated costs for the buyer's put options.

forward at a fixed price, buying a put option gives the producer higher probabilities for very high returns and for moderately low returns, lower probabilities for intermediate returns, but about the same average returns after subtracting option premiums.

Options offer a wider choice of risk-shifting possibilities than futures or Government price supports. Each different option strike price offers the prospective hedger a different probability distribution of prospective returns. Buying a high-priced, deep-in-the-money put is much like making a fixed-price sale; both tend to limit prospective net returns within a narrow range. At the other extreme, buying a low-priced, out-of-the-money put is similar to remaining unhedged. Futures and options offer a limited choice of delivery dates. Government programs offer only one set of terms to each farmer, albeit a loosely constrained set in that the terms apply over a broad time period.

Cash contracts can be sized to fit each farmer's needs, whereas futures contracts are traded in fixed quantities--5,000 or 1,000 bushels of grain or soybeans and 100 bales of cotton. The standard-sized futures contracts do not fit all farmers' needs. For example, one 5,000-bushel soybean contract covers the output of about 150 acres at current U.S. yields. This is too much for many small farmers, particularly those who cultivate on crop share leases. They would need to use the 1,000-bushel contracts traded on the Mid-America Exchange where transaction costs per bushel tend to be higher. The farmer who trades only a few contracts per year may not qualify for the same discounted commissions and may not receive or want to pay for the same market information services as the larger trader.

Futures and options are traded on highly competitive and liquid markets, assuring each trader easy access to the best bids and offers available. Extra time may be required to find the best deal in the cash market.

A Government price support loan covers all that is produced by the farmer who qualifies for the program, while a private contract covers only the quantity that the farmer has elected to sell.

The farmer who sells futures or enters a fixed-price cash forward contract is obligated to deliver the commodity or buy back the contract. This can result in substantial additional financial loss if the farmer experiences a crop failure combined with a price increase over the growing season. Farmers with crops eligible for price support and those who hold put options avoid the risk of having to buy themselves out of a contract on which they cannot deliver. Similarly, delivery requirements for minimum-price cash forward contracts generally do not pose problems for farmers in a short-crop, high-price year because farmers are not required to deliver more than they produce.

The farmer who holds futures or options contracts is exposed to basis risk. Basis risk is uncertainty about the difference between the futures price and the hedger's local cash price that

will prevail at the end of the hedging period. By entering a cash forward contract with a local buyer the farmer avoids dealing with basis risk directly. The basis risk is borne by the buyer who may take a slightly higher margin as a return for bearing this additional risk.

Holders of short futures positions receive margin calls when prices rise. A margin call is a short-term obligation that, for hedgers, is matched by a deferred gain since the value of the cash commodity being produced or stored increases by approximately the amount of the margin call. Margin calls can present serious cash-flow problems: the margin must be raised immediately, but the gain in value of the cash commodity cannot be realized until it is sold. If growers could readily borrow money for margin calls by using the enhanced value of their prospective crops as collateral, then margin calls would not be a problem. However, relatively few farm lenders seem ready to lend funds to farmers on short notice for meeting margin calls (Harris and Baker, 1981, 1982). This is partly due to the difficulty that lenders have in assuring that farmers maintain bona fide hedges. Consequently, avoidance of margin calls is an important consideration for farmers who operate with small financial reserves and without ready access to additional short-term credit.

Cash forward contracts are defaulted occasionally; the risk of default depends upon the financial condition and integrity of the opposite party. Futures and options contracts and Government programs are essentially free of default risk.

Some differences between price supports and private contracting not shown in table 1 deserve comment. Price support levels are normally set before planting each year; farmers can take out loans up to 6 months or more beyond harvest and may hold the loans up to 9 months before redeeming or forfeiting the commodity. In contrast, options with new, more distant maturity dates are introduced every few months providing 5 or 6 different maturity months each year; each option contract is traded for about 8-10 months, with active trading limited to 4-6 months, before it matures. This limits how far ahead minimum prices can be set with put options.

Finally, both futures and options require dealing through a broker, which may be inconvenient for some farmers.

Actual Use of Forward Contracts by Farmers

Active futures markets currently exist in the United States for eight raw farm products: corn, upland cotton, oats, soybeans, wheat, feeder cattle, live (fed) cattle, and hogs. Commodity options are traded for all of these commodities, except oats. Merchants and processors are the primary business users of these markets. Buyers of farm products extensively use these markets to offset the price risks assumed in entering cash forward contracts with farmers. Direct farmer use appears to be increasing as farms increase in size, farmers increase their

marketing skills, and price support levels decline relative to market prices.

The volume of futures trading in corn, soybeans, wheat, and cotton grew rapidly during the 1970's with increasing world trade and prices, but has fluctuated during the 1980's (fig. 1). Trading volume is a gauge of market activity and commissions generated but not necessarily a good measure of the hedging or risk-shifting services provided by futures markets. For the latter purpose, open interest (number of outstanding contracts) serves as a better measure (fig. 2). Options trading volume and open interest remain much smaller than futures trading volume and open interest.

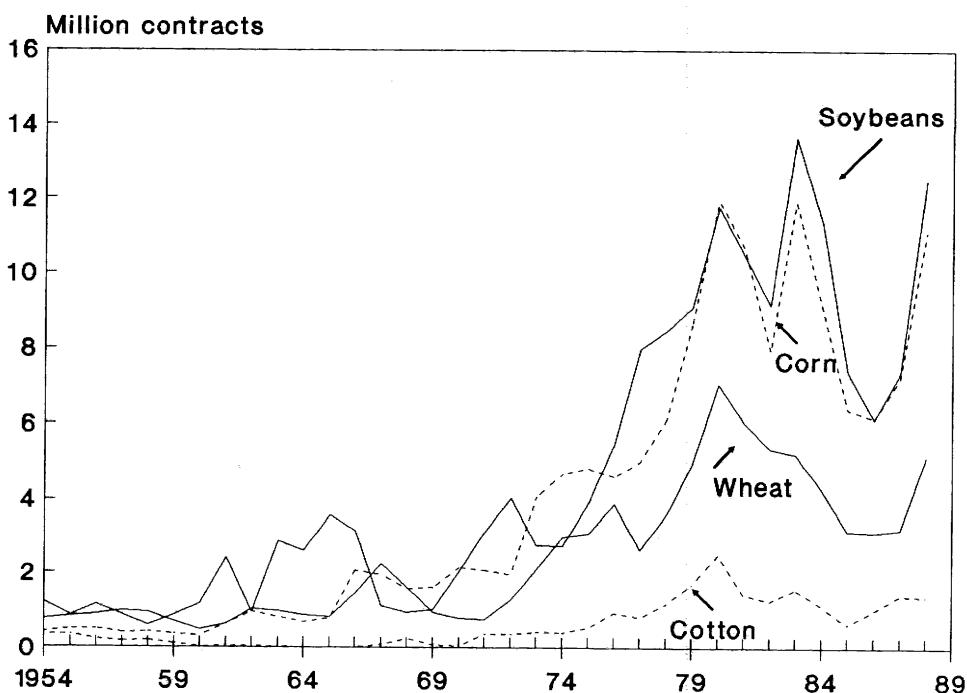
The extent of forward pricing by farmers varies by commodity produced, location, and year. No fully representative nationwide estimates are available, but recent studies suggest that farmers typically price forward 25-50 percent of their corn and soybeans and a smaller percentage of wheat and cotton.^{2/} Probably no more than 10 percent of these crops are forward priced directly in the futures and options markets, although use of futures and options is much higher for some groups of farmers.

A mid-1970's survey found that elevators purchased about 20 percent of the corn and soybeans and 14 percent of the wheat more

^{2/} Information about forward pricing by farmers from nine studies is summarized in a recent General Accounting Office study (1988).

Figure 1

Volume of trading in corn, soybean, wheat, and cotton futures, 1954-88



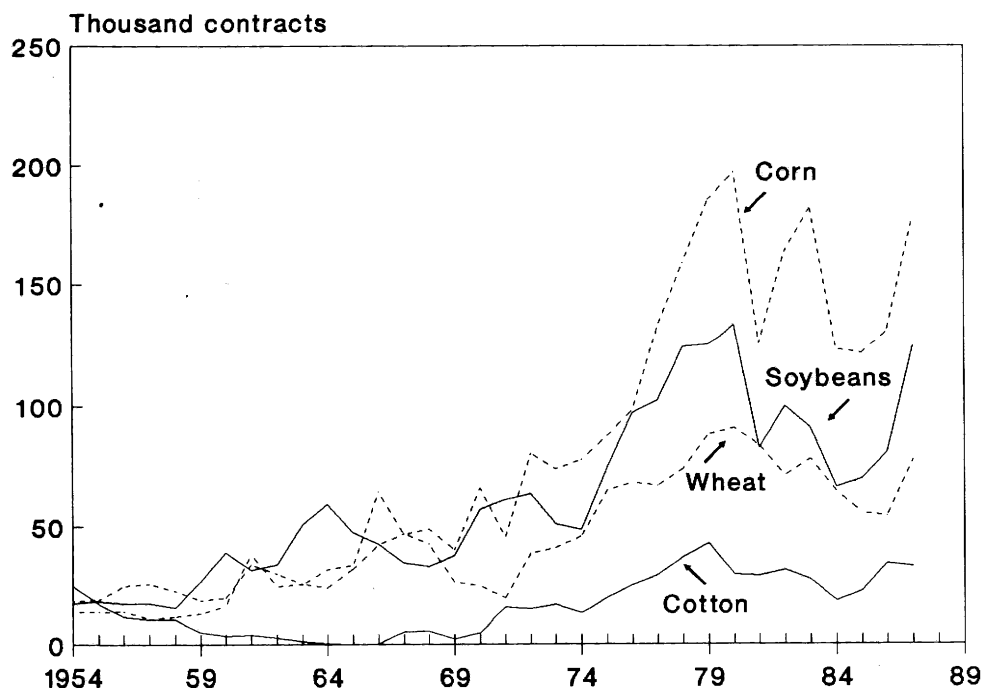
than 30 days before delivery (Heifner and others, 1977). A 1976 Commodity Futures Trading Commission survey of grain farmers found that 6.6 percent traded futures, but only 2.2 percent traded in commodities that they used or produced, and only part of these could be considered hedgers (Helmuth, 1977).

USDA collected information about farmers' contracting practices in the 1982 and 1983 Cost of Production Surveys (Harwood, Hoffman, and Leath, 1987a and 1987b; Hoffman, Harwood, and Leath, 1988; Leath, 1986; and Leath and Hacklander, 1984). Half or more of 1983 corn sales were through forward contracts in several Midwest States. Futures were used to price about one-fifth of the corn in Illinois, Indiana, Ohio, and Wisconsin, but use of futures was minimal in the other Midwest States. Percentages of soybeans contracted were similar to those of corn in the Midwest. Smaller percentages of soybeans were contracted in the Southern States, where about 75 percent of soybean sales were for spot delivery. However, cash-forward and price-later contracts accounted for a sizable portion of sales in some Southern States. Forward contracting of wheat was proportionately less than forward contracting for corn and soybeans. Approximately 8 percent of Kansas wheat, 14 percent of North Dakota wheat, and 13 percent of Colorado wheat was marketed under forward contracts. Wheat producers' direct use of the futures market was minimal.

In a 1986 mail survey of 9,100 farmers in 12 randomly selected States plus New England, 7 percent of the respondents reported that they had used futures, 3 percent had used agricultural

Figure 2

Average number of open contracts in corn, soybean, wheat, and cotton futures, 1954-88



options, and 24 percent had used cash forward contracts to market their primary commodity (Smith and others, 1989).^{3/} Use of futures or options was higher among corn and soybean producers than among wheat and cotton producers (table 2). Nearly half of corn and soybean producers and about one-third of wheat and cotton producers reported that they had used cash forward contracts to market their primary commodity.

A 1988 survey of 325 elevators in 13 Corn Belt and spring wheat States estimated the percentage of volume purchased from farmers under contract to be as follows (Wright, and others 1988):

<u>Commodity and region</u>	<u>Percent</u>
Corn, eastern Corn Belt	21.7
Corn, western Corn Belt	11.7
Soybeans, eastern Corn Belt	33.2
Soybeans, western Corn Belt	16.3
Spring wheat, Northern Plains	7.4

Since 1988 was a year when production was severely reduced and contracting was curtailed due to drought, these percentages are probably lower than they would have been under more normal conditions.

^{3/} The States surveyed included California, Colorado, Texas, Georgia, Illinois, Iowa, Kansas, Kentucky, Minnesota, New York, Tennessee, Washington, and the New England States. The sampling list was provided by a mailing list company that serves marketing newsletters. Names were selected randomly to provide the same proportion of farms in acreage size categories as in the 1982 Agricultural Census. The surveys were conducted in the various States between March and June 1986 with three followups to nonrespondents. The average response rate was 38 percent, ranging from 21 percent in Georgia to 45 percent in Kentucky.

Table 2--Percentage of farmers using futures, options, and cash forward contracts to market their primary commodity, 1986

<u>Primary commodity</u>	<u>Futures</u>	<u>Options</u>	<u>Forward contracts</u>
<u>Percent</u>			
Corn, grain sorghum, and soybeans	12	6	46
Wheat	7	4	34
Cotton	9	4	33
All respondents	7	3	24

Source: Smith, and others, 1987, 1989.

The relatively small amount of forward contracting by farmers has several possible explanations. First, many farmers rely on Government price supports instead of private contracting for downside risk protection. Second, forward contracting is not as effective in shifting risk for those who produce crops as for those who store commodities. Finally, some farmers may not be very risk averse and believe that price increases are more likely than price declines.

Effects of Forward Pricing on Farmers' Average Incomes

Pricing forward always results in either a higher or lower price than pricing at delivery, depending on whether the market price falls or rises over the contract period. Over a period of years, the farmer who sells forward will gain on some occasions and lose on others. This section considers how these gains and losses average out over many years.

Forward pricing can affect average income directly by changing the average net price received for products or the average net price paid for inputs. This occurs if forward prices exhibit risk premiums or bias, or if the farmer is more or less skillful than the average trader in forecasting price changes and timing trades. In addition, forward pricing may indirectly affect average income by reducing revenue uncertainty to the extent that the farmer can safely borrow more money and/or shift resources into expanded production.

Bias or Risk Premiums in Forward Prices

Any tendency for futures prices for a commodity to rise or fall on average over specific time intervals affects those who use the futures for hedging or speculation. A futures price is biased downward (upward) at a point in time if it lies below (above) the spot price then expected by well-informed traders to prevail when the futures contract matures. Some authors have suggested that a downward bias in futures prices is needed to attract long speculators into the market to take the opposite sides of short hedgers' positions. For example, Keynes (1930, pp. 142-44) argued that the "quoted forward price...must fall below the anticipated future spot price by at least the amount of the normal backwardation," the latter representing a remuneration for risk of price fluctuations during the intervening period. Hicks (1939, pp. 137-38) noted that the excess of planned sales over planned purchases makes it necessary for short hedgers to pay premiums to speculators for accepting the risks of price fluctuations. If such a bias existed, farmers and other short hedgers would, on the average, lose money on their futures positions.

Several more recent studies suggest that bias in futures prices is or should be small or negligible because the price risks in holding commodities are readily diversifiable. For example, Stiglitz (1983, p. 102) concluded that there is no theoretical reason for expecting futures prices to be strongly biased.

Risk-averse speculators "will reduce the magnitude of the bias in the market, but will not eliminate it."

Analysts have used three different approaches to measure bias or risk premiums in futures prices. The simplest and most direct approach is to observe how prices on individual futures contracts change on average over time. If futures prices are biased downward they will tend to rise as the delivery date approaches. Bias can be evaluated by testing whether average price changes over a number of observations differ from zero.

Efforts to measure bias in futures prices by averaging price changes over time have produced mixed results. The measured biases are frequently large enough to be economically important, but the possibility that they arise purely by chance cannot be ruled out using standard statistical tests. Paul (1986) found statistically significant upward trends in futures prices during the delivery period.

The gains and losses in 1988 dollars from holding short futures positions over the growing season during 1960-88 are represented by the vertical bars in figures 3-6 for corn, soybeans, wheat, and cotton. The growing seasons are mid-May to mid-November for corn, soybeans, and cotton, and mid-November to mid-June for winter wheat. Closing futures prices for the 15th or the trading day nearest to the 15th of each month were used for the figures. The figures illustrate the randomness in size and unpredictability of returns from holding short futures positions. The average return from holding a short position over the growing season was slightly negative for corn, soybeans, and cotton and slightly positive for wheat for the years analyzed, but these means were all small relative to their standard errors (table 3).

The second approach for assessing bias or risk premiums in futures prices grows out of the theory of efficient capital markets and the capital asset pricing model (CAPM). This approach does not measure bias directly but tests to determine if price relationships are such that a risk premium can be expected to exist. The CAPM implies that only those risks that cannot be spread or diversified command risk premiums when risk markets are efficient. Risks are diversifiable to the extent that they are uncorrelated with the risks on the "market portfolio," which contains all the assets in the economy. The expected risk premium is proportional to the regression coefficient obtained by regressing the returns from the specified asset, such as a commodity position, on the returns from the market portfolio.

The preponderance of evidence suggests that returns on commodity positions are not highly correlated with returns on other assets. This lack of correlation implies that the risk premiums required by investors or speculators for holding commodity positions should be small. Dusak (1973) concluded that wheat, corn, and soybeans traded at Chicago exhibited no risk premiums. Using different measures of market risk, Carter, Rausser, and Schmitz (1983) found nondiversifiable risks present in futures and supported the Keynesian theory of normal backwardation. In a

more recent study using a still different measure of market risk, So (1987) found no significant nondiversifiable risk for wheat, corn, and soybean futures during 1953-76.

The third approach for measuring bias or risk premiums in futures markets is to estimate the net profits or losses of different groups of traders. This calls for information about traders' actual positions as well as prices. Studies of gains and losses by specific groups of traders on futures markets are few because information about traders' positions is not often available. In an analysis of the daily positions over 4-1/2 years for 4,567 large traders reporting to the Commodity Futures Trading Commission, Hartzmark (1987) found that commercial traders (hedgers) made profits while noncommercial traders (speculators) earned negative or zero profits. He concluded: "Because speculators are not receiving rewards for the risks they willingly absorb, the theory of normal backwardation and its extensions can be rejected."

In summary, the preponderance of evidence suggests that futures prices for grains are virtually unbiased. However, there are some indications of bias against the short futures positions, particularly over the growing season, and the issue cannot be fully resolved (Grant, 1989, p. 14).

Rewards for Skillful Trading

Each dollar made by a trader in a futures or options market is lost by another trader. Those traders who are more skillful or

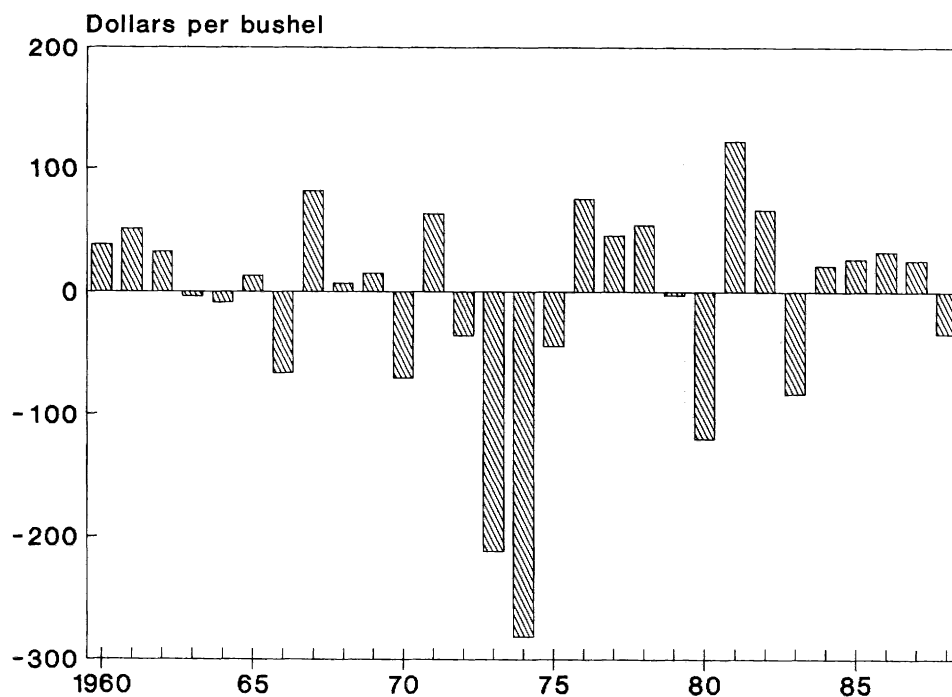
Table 3--Average returns on short futures positions held over selected intervals during the growing season for corn, soybeans, Kansas City wheat, and cotton, 1960-88 ^{1/}

Futures contract and time period	Mean	Standard error
<u>Cents per bushel</u>		
December corn, May 15 to Nov. 15	-6.6	16.0
November soybeans, May 15 to Nov. 15	-38.2	29.3
July Kansas City wheat, Nov. 15 to June 15	11.8	17.6
<u>Cents per pound</u>		
December cotton, May 15 to Nov. 15	-3.4	3.6

^{1/} Calculated from settlement prices on the 15th of the month or trading day nearest the 15th in 1988 dollars.

Figure 3

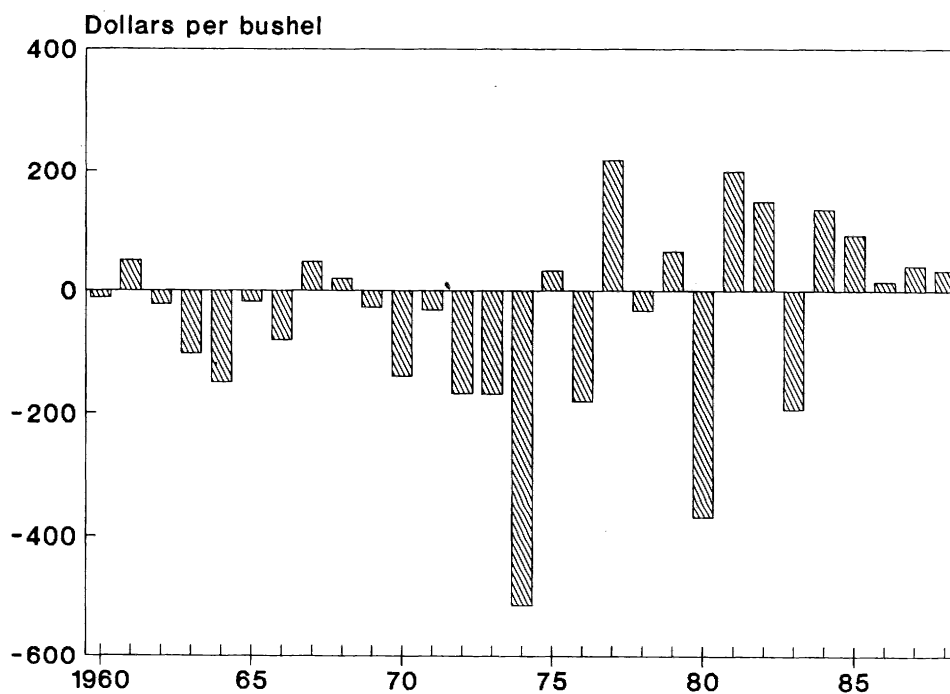
Returns from holding short positions in December corn futures from May 15 to November 15, 1960-88¹



¹In 1988 dollars.

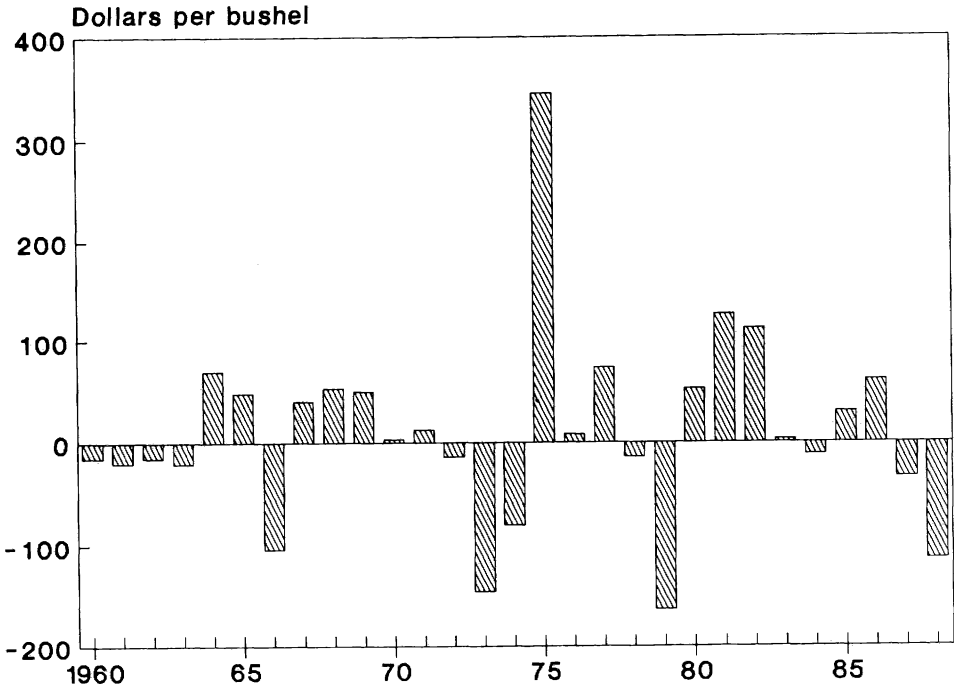
Figure 4

Returns from holding short positions in November soybean futures from May 15 to October 15, 1960-88¹



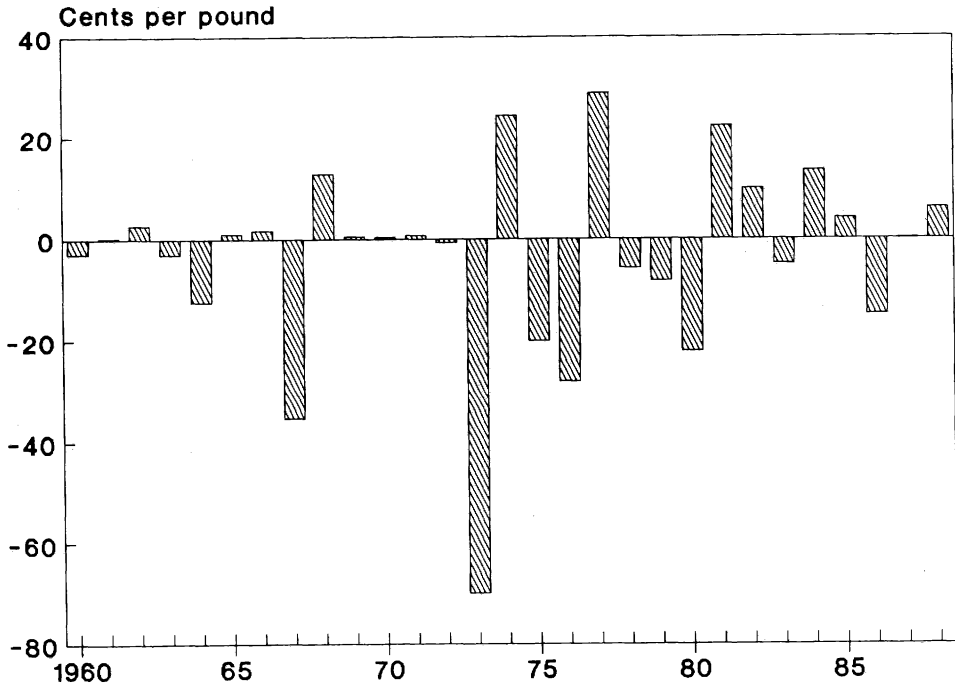
¹In 1988 dollars.

Figure 5
Returns from holding short positions in Kansas City July wheat futures from previous November 15 to June 15, 1960-88¹



¹In 1988 dollars.

Figure 6
Returns from holding short positions in December cotton futures from May 15 to November 15, 1960-88¹



¹In 1988 dollars.

luckier than average in forecasting price changes profit over the long run while those who are less skillful or unlucky lose.

Producers who can anticipate price changes can profit not only through pure speculation in futures or options but also by "selective hedging." Selective hedging involves entering and exiting hedging positions based upon anticipated changes in the forward price. This contrasts with "routine hedging," which involves holding futures or options positions during the same stage of each production cycle.

Some advocates of selective hedging suggest that a favorable price occurs sometime during almost every production period. They advise farmers to set a price goal that covers costs of production and sell only when the price meets the goal. Others recommend buying or selling based on the pattern of price movements. Most statistical analyses show futures markets to be nearly "efficient" (See Gordon, 1985, for example). This means that the current futures price approaches the best currently available forecast of the price at contract maturity. If markets were fully efficient, then farmers could not increase average returns from either selective hedging or speculation.

Futures and options markets probably approach perfect efficiency but never quite attain it. The futures price is forced toward the best estimate of the spot price that will prevail on the delivery date by knowledgeable speculators waiting to make profitable trades whenever the current price deviates from their forecasts. These knowledgeable speculators will only continue to trade if they are rewarded for their efforts. Thus, they have incentives to compete for speculative profits and drive these profits toward zero, but never all the way to zero. This leaves room for the more skillful speculators and selective hedgers to make profits in the markets commensurate with their price forecasting skills.

As a group, farmers are probably no better at price forecasting than the average trader. The limited information available shows that small traders lose money on the average in the futures market. Hartzmark (1987, p. 1269) found that "large traders earn significant positive dollar profits over the July 1977 to December 1981 period (and therefore small traders lose)." The large traders are those who hold positions that must be reported to the Commodity Futures Trading Commission. Most farmers would fall into the small trader category if they hedged because of the size of their operations. This suggests that farmers as a group are not likely to raise their average returns from selective hedging, although some of the more skillful may gain.

Trading Reduced Risk for Higher Average Returns

To the degree that forward pricing reduces a farmer's risk, some of the risk reduction may be traded off to increase average returns. For example, reduced risk might allow a farmer to safely concentrate more resources on a profitable enterprise or borrow additional money to expand operations. Bankers generally

will lend more funds to merchandisers and processors on hedged inventories than on unhedged inventories. However, bankers apparently are much less inclined to increase lending to farmers who hedge (Harris and Baker, 1981). This probably reflects the relative ineffectiveness of hedging for reducing growers' risks (as described in the next section), difficulties in assuring that farmers maintain bona fide hedges, and lack of familiarity with hedging by some farm lenders.

Finally, when many risk-averse producers avoid risks by forward pricing or by other means, we expect the supply curve to be shifted to the right. More is produced at any given level of expected price, and consumers benefit from lower prices. Whether individual farmers gain or lose depends upon whether the reduced risks compensate them for the lower prices they receive. In the long run, after farmers have had time to fully adjust to the lower risks, we would expect some to be better off and some to be worse off. Although society as a whole benefits, we cannot be sure that farmers as a group benefit from the lowered risks.

When all things are considered, forward pricing is not likely to change farmers' average incomes by very much. The gains will accrue to those who are most skillful or lucky in using the markets.

Forward Pricing and Farmers' Risks

Reducing risk, particularly the risks of critically low revenues, is a key motive for forward pricing.^{4/} Yield uncertainty makes forward pricing less effective in reducing revenue uncertainty in growing crops than in storing, processing, and merchandising commodities. Even with yield uncertainty, forward pricing generally reduces the farmer's uncertainty at planting time about the current year's crop revenues. However, forward pricing is not very effective in reducing current uncertainties about future years' revenues.

Active futures and options markets with widely reported prices provide growers, merchants, processors, and consumers information about each others' price expectations. This information can help individual farmers make improved production and storage decisions. Consistency of expectations contributes to improved coordination of production and consumption. However, these

^{4/} Some authors, notably Working (1953) and more recently Williams (1986 and 1987), have argued that risk aversion does not play a central role in futures trading. Both Williams (1986) and Telser (1986) suggested that futures markets exist primarily to facilitate commodity loans. In this report, we adhere to the more widely held view that risk aversion motivates much of the behavior of traders in commodity markets as well as in security markets.

benefits may be tempered to the extent that uninformed speculators introduce extraneous price variation into the market.

Evidence about the effects of futures and options trading on the variability of agricultural prices is not conclusive. For grains, soybeans, and cotton, we have no recent experience without futures trading to use for comparison. Moreover, Government programs have dampened grain and cotton price variability much of the time since the 1930's. Cattle and hog futures markets provide some basis for comparison because of their more recent origin and relative freedom from the influence of Government programs. Although earlier studies by Powers (1970) and Cox (1976) suggested that cattle and hog price variability declined after the advent of futures trading for these commodities, more recent work by Tomek (1979-80) showed no such effect.

The Nature of Farmers' Risks

Risk or uncertainty occurs as choices are made between alternatives with outcomes that are not fully predictable. The presence of uncertainty is demonstrated when outcomes differ from expectations. For example, a farmer may be uncertain at planting about revenues at harvest, uncertain at harvest about revenues from storing and selling later, or uncertain when investments are made in land and equipment about revenues in future years.

Uncertainty burdens farmers in several ways. First, many farmers are risk averse. They prefer a certain return over an uncertain return with equal expected value. Second, revenue uncertainty may make borrowing more difficult or interest rates higher for the farmer. Finally, uncertainty leads to suboptimal decisions even among risk-neutral decisionmakers. For example, uncertainty at planting prevents farmers from applying the exact quantities of inputs needed to maximize profits under each year's specific weather and price conditions.

Farmers face many uncertainties, particularly uncertainties about prices, yields, returns by enterprise, and total income. These uncertainties apply to outcomes in future years as well as in the current year. To fully evaluate a farmer's risk exposure, we would need to combine these various uncertainties into a single overall measure of uncertainty of wealth or well-being. Such a measure would be strongly affected by the farmer's initial assets, enterprise mix, and off-farm income. Lacking satisfactory means to quantify all of these factors, this study focuses on uncertainty of returns by enterprise.

Measuring uncertainty requires comparing outcomes with expectations. Futures markets are among the few places where expectations are observable. We use futures prices as proxies for farmers' price expectations up to a year ahead. Longer term price expectations are approximated by historical average annual prices adjusted for inflation.

Changes in Price Uncertainty Over Time

Uncertainty about crop returns decreases as harvest approaches and as yields and prices at harvest become known. Price uncertainty can be gauged by observing historical differences between futures prices and subsequent spot prices. The heights of the bars in figure 7 represent the magnitude of the errors during the preceding months in anticipating corn prices in December. The figure was constructed using deflated midmonth closing prices for December corn futures for 1960-88. Each bar measures the standard deviation of the difference between the December futures price for the month indicated and the December futures price for the following December. These standard deviations decline from about 94 cents per bushel in January before harvest to about 21 cents per bushel in October.

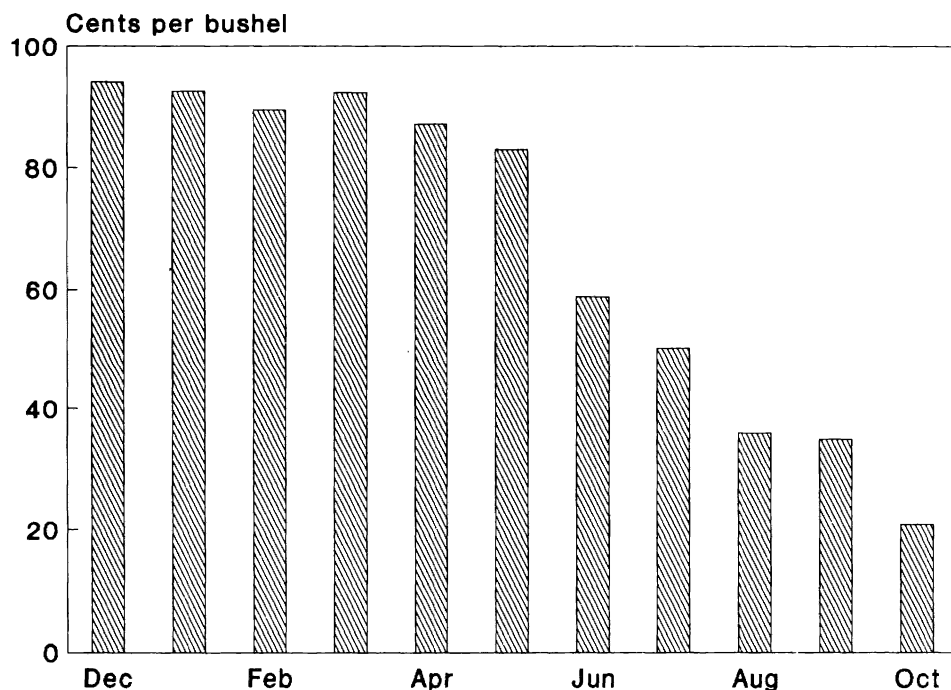
The standard deviation of the deflated December corn futures price in December was about \$1.30 per bushel for 1960-88 (table 4). When the December price was detrended by taking differences from its lagged 5-year moving average, the estimated standard deviation was \$1.19. These estimates suggest that a quarter to a third of the long-term uncertainty about December corn prices is resolved for each crop before planting time, an additional half is resolved over the growing season, and up to a quarter of the uncertainty remains to be resolved after harvest.

Risk-Reducing Contracts

Farmers are generally long in the commodities that they produce--they either own the commodities or own inputs for producing the

Figure 7

Standard deviations of differences between expected and realized prices for December corn, 1960-88¹



¹In 1988 dollars.

commodities and expect to sell later. Consequently, farmers generally can reduce exposure to price variation by holding short futures positions, put options, or fixed- or minimum-price cash forward sales contracts. The holding of long futures or call options to offset short positions in cash markets is not discussed here because it is relatively less important for crop producers. An exception is the case where the crop has been sold and the farmer remains eligible for Government deficiency payments that would be diminished by increases in market prices. Livestock producers who expect to buy feed in the future can also reduce price risks by holding long positions in forward markets.

Government loans provide farmers price guarantees similar to those obtained by holding put options or minimum-price contracts. Yield variability prevents either type of price guarantee from completely eliminating revenue uncertainty. Government loan eligibility applies to all that the farmer grows, while put options or minimum-price cash forward contracts cover only the amount contracted. Thus, Government loan eligibility provides producers somewhat broader price protection in any given year than holding put options with strike prices equivalent to the loan rate.

The question of whether Government loans provide farmers greater price protection over a period of years than forward pricing alone is quite complex. Government loan and storage programs can, in theory, provide greater interyear price stability but only when managed skillfully and even then at some cost to taxpayers. Interyear stock-carrying can eliminate part of the yearly fluctuations in aggregate consumption and prices, but complete stabilization of agricultural prices is impossible. Either a succession of good harvests results in excessively costly stock accumulations or a succession of bad harvests fully depletes the Government's stocks (Plato and Gordon, 1984).

Table 4--Standard deviations of deflated futures prices across years for selected planting and harvest dates, 1960-88 ^{1/}

Futures contract	Planting	Harvest
<u>Cents per bushel</u>		
December corn	87.8	129.5
November soybeans	181.1	258.3
July Kansas City wheat	179.1	166.8
<u>Cents per pound</u>		
December cotton	23.0	30.2

^{1/} Planting date is May 15 and the harvest date is November 15 for corn, soybeans, and cotton, and November 15 and June 15 for wheat. Prices are in 1988 dollars.

Moreover, profit-seeking private storers can be expected to carry optimal intrayear stocks if markets are efficient. The underlying issue is whether the added price stability available through Government loan and storage programs is worth the cost.

Effectiveness of Forward Pricing in Reducing Risks

Because of yield uncertainty, most crop producers who use futures or cash forward contracts to minimize revenue risks do so by pricing only part of their expected output before harvest. Forward sales generally can reduce the dispersion of realized revenues around expectations at planting by a third to a half. However, routine forward pricing at planting generally reduces the year-to-year variability of revenues by less than 20 percent because futures prices at planting are almost as variable as prices at harvest.

The optimal forward sale for each producer depends on (1) the expected change in the futures price, (2) the variability of prices and yields and their correlation, and (3) the producer's degree of risk aversion. If the futures price is unbiased (expected futures price change is zero) and trading costs are negligible, then the forward sale that minimizes the farmer's risk is the optimal forward sale.

Forward pricing is most effective in reducing the crop producer's risk when yield uncertainty is small and the product being produced is close in location and grade to that required for making delivery on the contract. A high percentage of revenue uncertainty can be eliminated by forward pricing when yield uncertainty is absent, as it is with storage.

Basis risk must be considered when futures or options contracts are used to price forward. Basis risk arises from uncertainty about the difference between the cash price and the futures price that will prevail when the hedge is closed. It is negligible if the product being hedged is conveniently deliverable on the futures contract; it may be large if the product hedged differs substantially in quality or location from the product required for delivery on the futures. If both yield and basis were certain, then essentially all return risk would be eliminated by selling the entire crop forward.

Grant (1989) has estimated that minimum-risk forward sales at planting typically range from 20 percent to 90 percent of expected output for corn and soybean growers. Such hedges eliminate 0-70 percent of the revenue uncertainty that exists at planting. He points out that the amount of risk eliminated typically varies only 3-6 percent when forward sales vary from 20 percent below to 20 percent above the minimum-risk level. Grant's results are in terms of variances and are based upon State yields and yields for Iowa, Nebraska, and North Carolina counties for 1961-83.

Yield variability is generally higher and the risk-reducing effectiveness of forward pricing is generally lower when measured

at the farm level than at the county or State level. Miller and Kahl (1989) studied hedging effectiveness for soybeans using 1970-84 yields for seven Illinois farms. They found that forward selling 60 percent of the expected crop would have reduced revenue variances for the years 1970-84 by 24-36 percent for six farms while increasing revenue variance by 9 percent for one farm. When 1974 was excluded, the estimated reductions in revenue variance ranged from 39 percent to 48 percent for all seven farms.

Farmers are affected by uncertainty about future years' revenues as well as the current year's revenue. These concerns come to the forefront when acquiring inputs, such as land, machines, and farming skills, which do not pay for themselves in the first year of use. Without multiyear contracts, forward pricing clearly cannot fully eliminate uncertainty about future years' revenues. Nonetheless, routine hedging may make revenues more predictable than otherwise.

Price Variability at Planting and at Harvest

The ability of forward selling to reduce uncertainty about future revenues partly depends on the variability of forward prices at planting relative to the variability of spot prices after harvest. Tomek and Gray (1970) concluded that routine hedging of corn and soybeans during 1952-68 would not have reduced the variability of farmers' revenues. During this period, planting time prices of futures for harvesttime delivery varied almost as much between years as harvesttime prices varied.

Variabilities of futures prices at planting and harvest for corn, soybeans, wheat, and cotton for 1960-88 are compared in table 4. The standard deviations of deflated corn, soybean, and cotton prices at planting were 68-76 percent of their respective standard deviations at harvest for this time interval. These results, which include the large price fluctuations of the early seventies, suggest that forward pricing holds more potential for reducing interyear revenue variability than Tomek and Gray (1970) found. However, when only the years 1976-88 are included in the analysis, prices, at planting are 84-97 percent as variable as harvest prices. The standard deviation of July wheat futures prices was larger at planting in the fall than at harvest during 1976-88 as well as during 1960-88.

Revenue Variability With and Without Forward Pricing

One must take into account variability in yields and costs of inputs as well as variability in product prices to fully gauge the effects of forward pricing on farmers' income variability. For this purpose, we applied the procedure described in Appendix II to estimate both current-year and future-year risk-shifting effectiveness for representative crop growing and storage situations using 1960-88 futures prices, input prices, and State yields. The procedure involves first calculating expected revenues for each year and then calculating the standard deviations of the differences between realized revenues and

expected revenues. Prices of maturing futures contracts at harvest were used to represent cash prices; futures prices at planting for delivery at harvest were used as current-year expected selling prices; and historical average prices served as proxies for longterm price expectations. Input costs were introduced explicitly in order to measure variability of net returns accruing to the fixed inputs used in crop growing.

Estimates of the effects of forward pricing 50 percent of each expected crop at planting on the level and variability of farmers' revenues are reported in tables 5, 6, and 7 for corn, soybeans, cotton, and wheat for selected States during 1960-88. Effects on gross revenues are shown in table 5, net revenues in table 6, and revenue deviations from expectations at planting in table 7. Routine forward pricing would have changed average gross and net revenues by no more than plus or minus 3 percent except for cotton where net revenues would have been 5 and 7 percent lower due to increases in futures prices over the growing season. The standard deviations of gross and net revenues would have been reduced from 0 to 20 percent by pricing one-half of each expected crop at planting. If the analysis were limited to the years 1976-88, the estimated effects on average revenues

Table 5--Effects of routine forward pricing on level and variability of gross revenues from growing corn, soybeans, cotton, and wheat, selected locations, 1960-88 1/

Commodity and State	Mean			Standard deviation		
	Without forward pricing	With forward pricing	Differ- ence	Without forward pricing	With forward pricing	Differ- ence
	<u>Dollars per acre</u>		<u>Percent</u>	<u>Dollars per acre</u>		<u>Percent</u>
Corn:						
Iowa	455	451	-1	155	127	-18
North Carolina	323	320	-1	136	116	-15
Ohio	434	431	-1	133	112	-16
Soybeans:						
Arkansas	228	224	-2	64	59	-7
Georgia	247	243	-2	115	106	-8
Illinois	344	337	-2	86	77	-11
Cotton:						
Alabama	520	510	-2	183	171	-7
Arizona	1,229	1,207	-2	404	351	-13
Winter wheat:						
Kansas	164	166	+1	63	61	-3
Texas	106	107	+1	48	48	0

1/ 1988 dollars.

generally would remain in the 3-percent range, while the estimated effects on revenue variability would range from -13 percent to 9 percent. Overall, it appears that forward pricing at planting can reduce farmers' year-to-year revenue variabilities modestly during periods of widely fluctuating prices, but has little perceptible effect when prices are more quiescent.

The estimates in table 7 indicate that routinely forward pricing half of the expected crop at planting would have reduced farmers' errors in anticipating returns by 9-41 percent. When only 1976-88 data are included, the estimated reductions range up to 39 percent, with one case showing an increase in revenue uncertainty from pricing forward. The estimates shown in table 7 of the effects of forward pricing on current-year revenue uncertainty in crop production are similar in magnitude to those obtained by Grant (1989) and Miller and Kahl (1989).

The limited effectiveness of forward pricing for reducing crop growers' risks helps to explain why more farmers do not use futures and cash forward contracts. If reducing revenue risks in crop growing is important, then other mechanisms, such as crop

Table 6--Effects of routine forward pricing on level and variability of net revenues from growing corn, soybeans, cotton, and wheat, selected locations, 1960-88 1/

Commodity and State	Mean			Standard deviation		
	Without forward pricing	With forward pricing	Differ- ence	Without forward pricing	With forward pricing	Differ- ence
	<u>Dollars per acre</u>		<u>Percent</u>	<u>Dollars per acre</u>		<u>Percent</u>
Corn:						
Iowa	287	283	-1	147	117	-20
North Carolina	129	127	-2	127	105	-17
Ohio	243	240	-1	120	96	-20
Soybeans:						
Arkansas	166	161	-3	63	58	-8
Georgia	137	133	-3	112	104	-7
Illinois	271	264	-3	83	74	-12
Cotton:						
Alabama	545	510	-7	166	153	-8
Arizona	468	446	-5	384	326	-15
Winter wheat:						
Kansas	104	106	+2	60	57	-5
Texas	47	48	+2	45	44	-1

1/ 1988 dollars.

yield insurance or revenue insurance, need to be considered in combination with, or instead of, forward pricing.

Options Compared With Fixed-Price Contracts

Commodity options or minimum-price contracts offer farmers choices among probability distributions of returns not available through fixed-price contracting. Put options allow farmers to choose among distributions of returns that are skewed to the right--distributions with long upper tails. Many farmers and other decisionmakers appear to prefer this positive skewness in prospective returns; they like to have a chance of obtaining the extra high returns associated with a price rise. The average returns expected with options are essentially the same as with fixed-price contracts, and fixed-price contracts can generally provide distributions of returns with smaller variances than options.

The concept of an optimal or minimum-risk forward sale is not operationally useful with options because it disregards skewness in the distribution of revenues. Skewness is a major factor in choosing between options and futures and choosing among different

Table 7--Effects of routine forward pricing on the variability of revenue deviations from planting time expectations for growing corn, soybeans, cotton, and wheat, selected locations, 1960-88 ^{1/}

Crop and State	Standard Deviation		
	Without forward pricing	With forward pricing	Difference
	<u>Dollars per acre</u>		<u>Percent</u>
Corn:			
Iowa	105	68	-35
North Carolina	96	70	-27
Ohio	78	46	-41
Soybeans:			
Arkansas	35	30	-14
Georgia	94	85	-9
Illinois	46	35	-25
Cotton:			
Alabama	139	124	-11
Arizona	244	147	-40
Winter wheat:			
Kansas	49	38	-23
Texas	38	34	-11

^{1/} 1988 dollars.

options contracts. Although futures positions generally provide a lower variance of return for any given mean return than do options positions, options may be preferred by individuals who desire skewed returns. Not enough is known about individuals' preferences for skewness to establish general criteria for optimizing options positions.

Impacts on Realized Price

The relationships between realized price and end-of-period market price under fixed-price contracting and minimum-price contracting are compared in figure 8 for the case where yield risk is absent. The cumulative probability distributions of realized return for different types of contracts are also shown.

Without contracting, the realized price is the end-of-period market price as shown by the 45-degree line in panel a. A fixed-price contract makes the realized price a horizontal line at the contract price P_0 as shown in panel c. With minimum-price contracting, shown in panel e, the realized price is P_0 if the market price is less than P_0 and otherwise equals the market price. For this illustration, we assume that the minimum price contract is available without paying a premium.

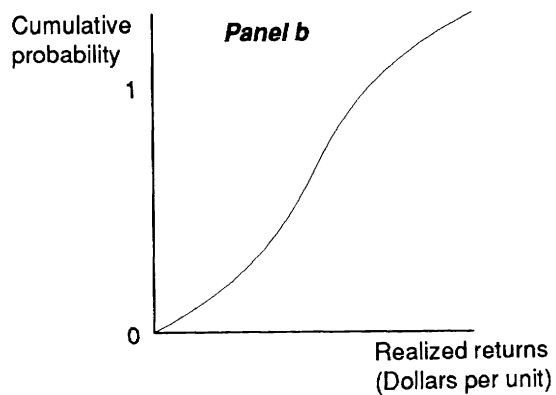
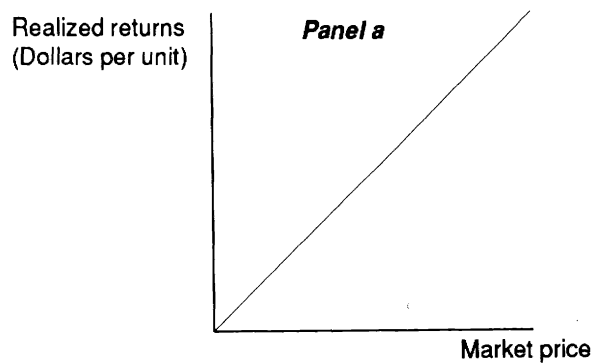
Panels b, d, and f in figure 8 show cumulative probability distributions for the realized price; the height of the function measures the probability of realizing prices less than the value on the horizontal axis. Without contracting, the cumulative distribution is S-shaped as shown in panel b; the steeper slope near the center reflects the greater frequency of prices near the mean. Under a contract that fixes the price, the cumulative distribution is a horizontal line at zero up to P_0 and a horizontal line at 1 thereafter as shown in panel d. Panel f illustrates a cumulative distribution of revenue under a minimum-price sale, which corresponds to the cumulative distribution for a fixed-price sale for market prices up to P_0 , and with the cumulative distribution without forward pricing for higher prices.

Figure 9 shows relationships between the realized return per unit and the end-of-period futures price for six types of futures and options positions entered when the futures price equals F_0 . Panels a and b represent long and short futures positions, respectively. In both cases, the realized return is zero when the end-of-period price equals F_0 . Panel a shows the realized return on a long position increasing directly with the futures price, while panel b shows the realized return on a short futures position decreasing as the futures price increases.

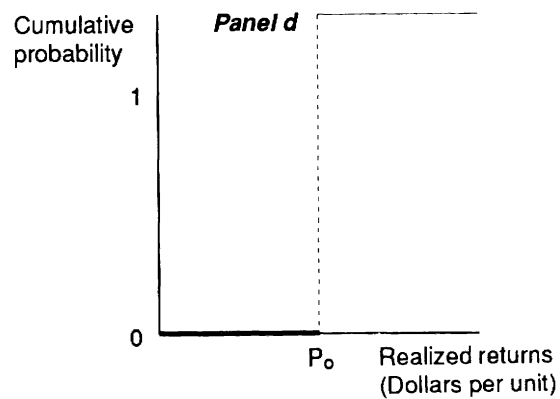
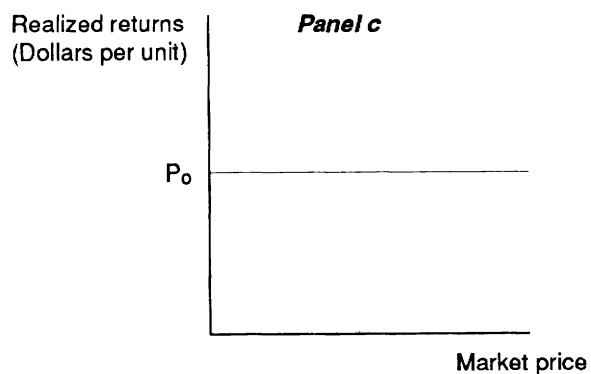
The four bottom panels of figure 9 show functional relationships between the end-of-period futures price and the realized return for at-the-money option contracts. Two relationships are shown in each panel. The dashed line represents the relationship without taking the option premium into account. The solid line shows the relationship after the option premium is subtracted for option holders or added for option grantors.

Figure 8
Effect of the market price on realized returns and the cumulative distribution of realized returns with and without forward pricing

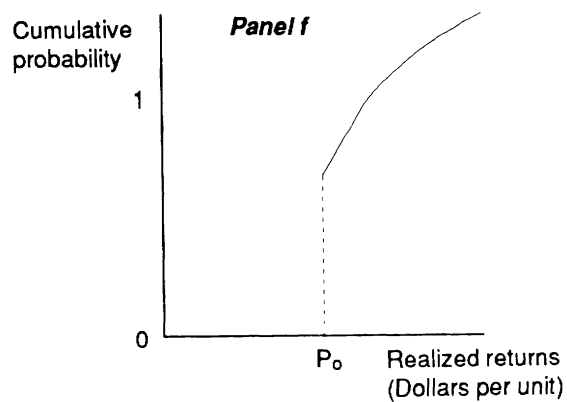
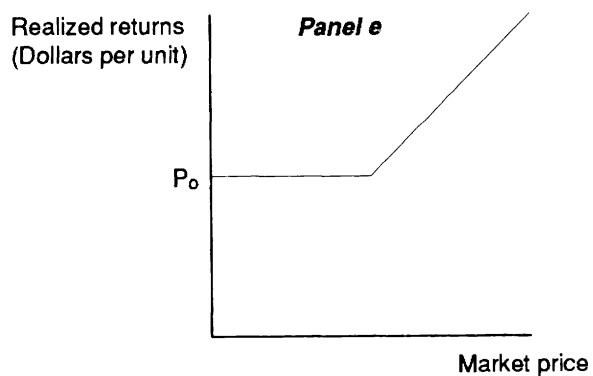
Without pricing forward



With fixed-price sale



With minimum-price sale



For call option positions, shown in panels c and d, the realized return before adding or subtracting the option premium is zero for end-of-period market prices below the strike price F_0 ; as the price increases above F_0 , the holder gains and the grantor loses. When the option premium is included, the return is negative for the option holder and positive for the option grantor for end-of-period futures prices below F_0 .

For puts, shown in panels d and e, the realized return before adding or subtracting the premium is zero for futures prices above the strike price; it increases for the holder and decreases for the grantor as the price declines below the strike price. The figure shows that option holders are subject to losing the premiums paid for the options but not more. Losses on writing puts are limited since the price does not fall below zero. Losses on writing calls are theoretically unlimited since there is no upward price limit. If options markets are efficient, the average return after adjusting for premium costs and excluding commissions will approach zero for both option holders and option grantors.

Producers with long cash positions can change their exposure to price variations by entering futures and options positions. If cash and futures prices move together, the net relationship between the market price and the realized return can be represented by adding vertically the appropriate function from figure 9 to the function represented in panel a of figure 8. For example, combining a short futures position (panel b of figure 9) with a long cash position (panel a of figure 8) gives a horizontal line at the current market price showing its equivalence to holding a cash position with a fixed-price sale (panel c of figure 8). Adding a put option (panel e of figure 9) to a long cash position (panel a of figure 8) is similarly equivalent to a long cash position with a minimum-price sale (panel e of figure 8).

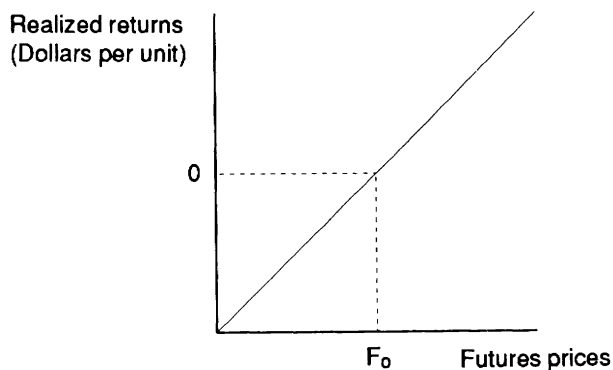
Various combinations of options and futures contracts can be shown to offer equivalent price risk exposure. The more important of these equivalences are laid out in Appendix III.

The net price assured by buying a put option is always less than the net price assured by selling the underlying futures contract. For buying puts, the assured net price is the strike price minus the option premium plus the end-of-period basis (which is negative for most farmers). For hedging with futures, the assured net price is simply the futures price plus the end-of-period basis. The following are assured net prices, assuming zero basis, for July wheat put options with different strike prices quoted at the close of trading on March 30, 1988:

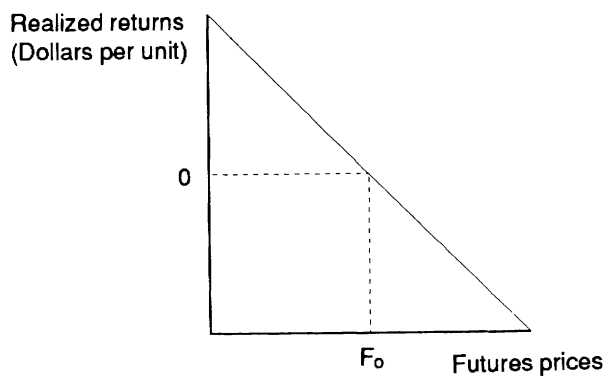
Figure 9

Realized returns related to the market price for futures and options positions

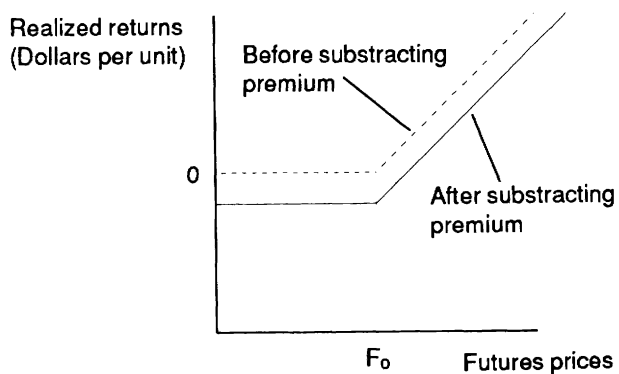
Panel a: Long futures



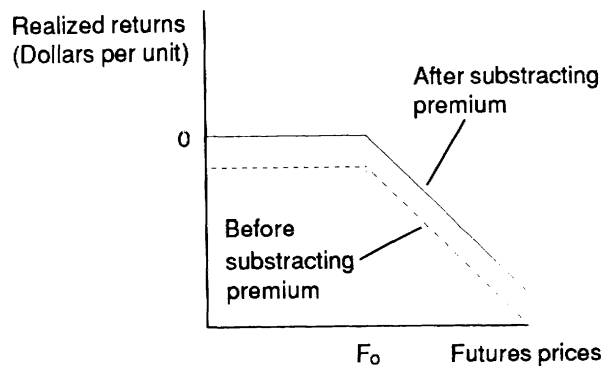
Panel b: Short futures



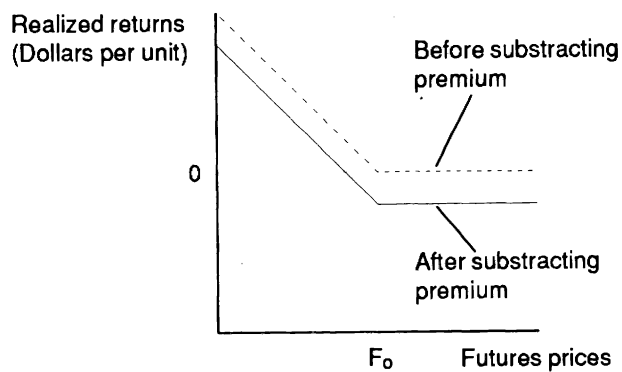
Panel c: Hold at-the-money call



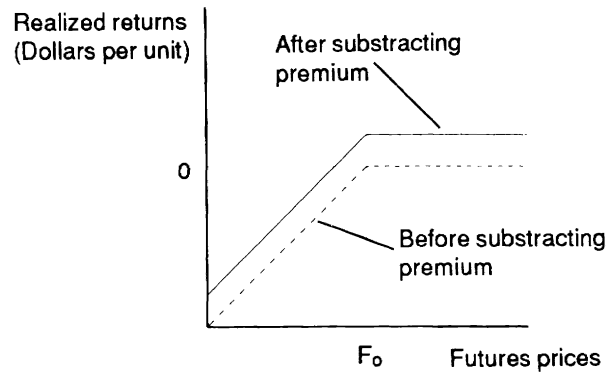
Panel d: Grant at-the-money call



Panel e: Hold at-the-money put



Panel f: Grant at-the-money put



<u>Strike price</u>	<u>Option premium</u>	<u>Assured net price, excluding basis</u>
<u>Dollars per bushel</u>		
2.80	.02 1/8	2.77 7/8
2.90	.04	2.86
3.00	.08	2.92
3.10	.12 1/8	2.97 7/8
3.20	.17 1/2	3.02 1/2
3.30	.25 1/4	3.04 3/4
Futures price	3.08 3/4	3.08 3/4

This example illustrates how the assured net price for puts increases as the strike price increases, but it is never as high as the net price assured by selling the futures. The table does not show the upside price advantage of the options, which is left for a later section in this report.

Implications of Yield Variability

We turn now to the implications of yield variability for choosing between put options and futures contracts. As yield variability increases, revenue uncertainty increases for all types of contracts, the notion of an assured net return loses meaning, and the differences between different types of contracts become somewhat blurred. These effects are illustrated here with probability distributions constructed through computer simulation.

When producers sell futures, or fixed-price cash forward contracts, the probabilities of high returns and of low returns are both reduced more or less equally. But, with the purchase of put options or use of minimum-price cash forward contracts, the effect is asymmetrical. Probabilities of extremely low returns are reduced more than the probabilities of extremely high returns. The resulting probability distribution of returns is skewed to the right (long upper tails). The nature of this skewness is illustrated in figure 10 for a grower with yield risk but no basis risk. The figure illustrates the probability distributions at planting for revenue from growing soybeans under three pricing strategies: selling at harvest, selling 80 percent at planting and the remainder at harvest, and buying at-the-money put options at planting to cover the expected crop.

Because forward prices are believed to be approximately unbiased, as discussed previously, the three distributions shown in figure 10 were constructed to have equal means. Buying a put option shifts gross returns upward by cutting off part of the lower tail of the distribution. But, if the options market is working well, the option premium equals the increase in the average gross return and the expected net return remains unchanged, except for transactions costs. The figure is based upon an expected yield of 35 bushels per acre with a standard deviation of 7.7 bushels per acre, an expected price of \$8.00 per bushel with a standard deviation of \$2.20 per bushel, and a correlation between price

and yield of -0.2. Option premiums were calculated using the Black (1976) formula.

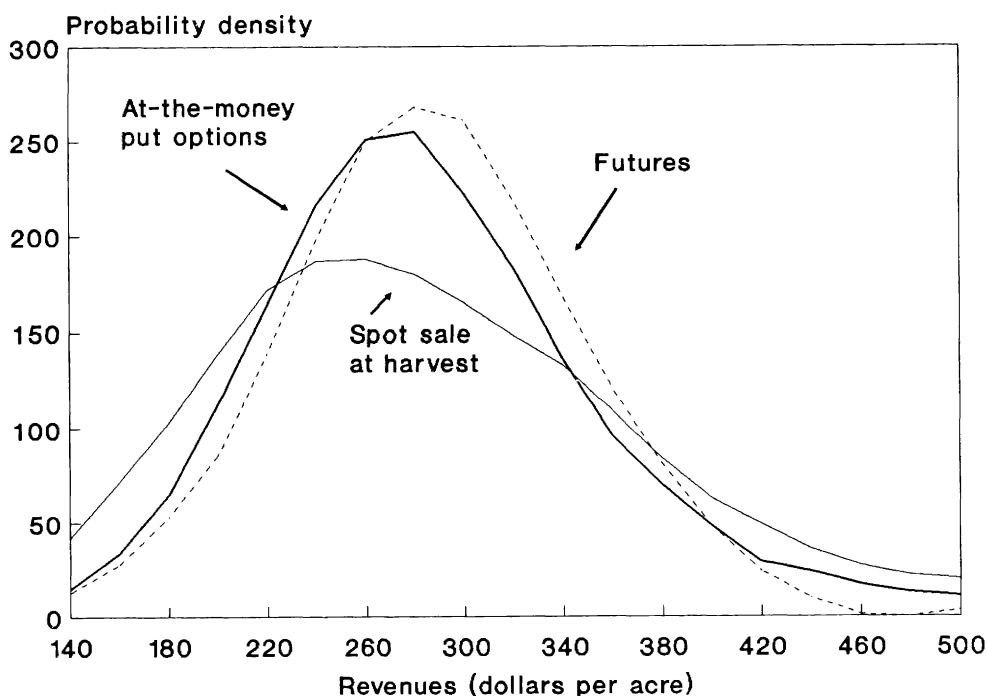
In choosing among different strike prices, the put option buyer is choosing among revenue distributions with similar means but different degrees of skewness. These differences are illustrated in figure 11 for three strike prices: \$9.50 (deep-in-the-money); \$8.00 (at-the-money); and \$6.50 (out-of-the-money). For deep-in-the-money puts with high strike prices, the revenue distributions are peaked, much like the distribution for selling futures. For puts with low strike prices, which are far out of the money, the revenue distribution is flatter, more like the distribution for spot sales at harvest.

The choice among fixed-price sales and put options with different strike prices depends upon the farmer's degree of preference for positive skewness in revenues. Preference for skewness appears to vary among farmers, and we have no good measures of it.^{5/} The analyst can describe the revenue distributions that result from different contracting strategies, but the choice among distributions is up to the decisionmaker.

^{5/} See Kraus and Litzenberger for a discussion of preference for skewness.

Figure 10

Probability distributions of revenues from soybean growing and selling at harvest, hedging in futures, and hedging with at-the-money put options



Possibilities for Futures-Options Programs 6/

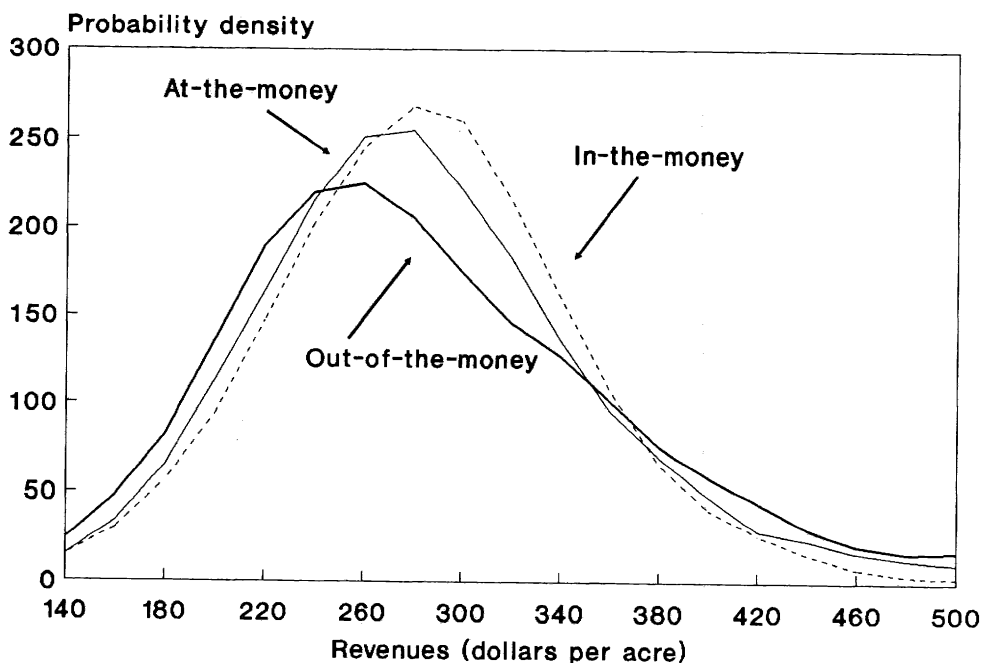
Interest in modifying farm programs to expand farmers' direct or indirect use of commodity futures or options markets has emerged with the advent and growth of modern agricultural options trading and the increased understanding of the pricing and risk-shifting capabilities of forward markets. While offering farmers protection against price declines similar to that provided by futures markets, put options provide farmers a wider range of pricing alternatives. For example, growers of commodities traded on options markets can choose from up to 20 different combinations of strike prices and maturity dates, while only one level of price support is available under the Government loan program.

Although current and past farm programs have raised farmers' incomes, the programs have been costly and have frequently resulted in overproduction, excess stocks, and higher than necessary food costs. The free price guarantees available to farmers through price supports reduce farmers' needs to hedge, leaving futures and options markets less active and less liquid than otherwise. These problems suggest looking at program alternatives that allow more decisions to be made in the marketplace.

6/ This section draws upon and extends the ideas presented in Heifner and Sporleder (1988).

Figure 11

Probability distributions of revenues from soybean growing and hedging with out-of-the-money, at-the-money, and in-the-money put options



Expanded farmer trading of futures and options could be part of a move toward a "free market" for agricultural commodities. Kahl (1985) listed the following benefits from replacing Government programs with agricultural options: (1) "allow the market to give accurate price signals for the optimal allocation of resources," (2) "provide farmers more flexibility and more control in determining how much price protection they needed... Farmers would then have an incentive to economize in risk management," and (3) "taxpayers would no longer be burdened with the cost of providing price protection to farmers."

A nationwide futures-options program could (1) partly or completely replace existing programs, (2) offer farmers an alternative to existing programs, or (3) provide added benefits above those offered by existing programs. If offered as an alternative, the futures-options program would win participants only to the extent that its benefits appealed to farmers more than the regular program. The futures-options pilot program for 1988-89 provided added benefits for farmers in the 41 selected counties because pilot program participants remained eligible for Government price support loans and deficiency payments.

A futures-options program could substitute only for price supports or for price supports and other program provisions. Parts of existing programs likely would be retained if a futures-options program were implemented. For example, price supports might be dropped while retaining acreage controls and deficiency payments. The income raising effects of price supports could be either eliminated or provided through some new type of payment to participants, such as subsidizing farmers' use of put options.

History of Government Involvement With Futures and Options Markets

Since the advent of commodity futures trading in the United States during the mid-1800's, Government policy toward futures and options markets has ranged from pure laissez faire to outright prohibition of some forms of trading. The Federal Farm Board actually traded futures contracts in 1930-33 in an effort to stabilize wheat prices.^{7/} Commodity options trading was prohibited by law from 1936 to 1984 and onion futures trading has been banned since 1958.

Government policy regarding futures and options trading has aimed mainly at preventing abuses through regulation. Important events in the regulation of agricultural futures and options trading include the passage of the Grain Futures Act in 1922, which established a Federal role in regulating grain futures markets; the passage of the Commodity Exchange Act in 1936, which extended regulation to other agricultural commodities, imposed limits on speculative positions, and prohibited options trading; the

^{7/} See Peck (1978) for an analysis of the Federal Farm Board's experience.

passage of the Commodity Futures Trading Commission Act of 1974, which strengthened regulation and extended it to all futures trading; and the passage of the Futures Trading Act of 1982, which lifted the ban on agricultural commodity options trading beginning in October 1984.

The Federal Government has helped educate farmers about futures and options trading through programs of the Extension Service and the Commodity Futures Trading Commission. New extension marketing programs emphasizing futures were initiated in several States, and old programs were expanded during the 1970's and early 1980's. The Extension Service sponsored the development of training materials in agricultural options trading in 1984 (McKissick, and others, 1984). Although the Government has not actively traded futures since 1933, a proposal by Hendrick Houthakker (1967) for price stabilization through Government futures trading received considerable attention. Houthakker maintained that a Government role in stabilization was needed because "government can and should take a longer view than most private individuals or business firms.... The use of the futures market instead of the spot market is intended to withdraw the government from the detailed process of marketing and storage, which is much better left to farmers and traders." Under Houthakker's proposal, "the government, through a specialized agency, would stand ready to buy a specified futures contract if the price falls to a predetermined floor and to sell the contract if the price rises to a specified ceiling."

Several proposals for Government use of options have been advanced in recent years. Gardner (1977, pp. 990-91) suggested two ways that the Government might use options markets for stabilization purposes. First, the Government's ability to make delivery on international grain agreements might be guaranteed by acquiring call options instead of carrying stocks. Second, in partial return for the benefits of price supports, farmers might be required to give the Government call options to buy grain at, say, twice the loan level.

Schertz (1985) suggested two approaches to merge price supports and commodity options: (1) have the Government accept bids from speculators to write put contracts at exercise prices (see "Glossary") consistent with the desired price support level for distribution to producers, or (2) provide a specified subsidy to each producer who purchased put options. Petzel (1984) suggested subsidizing farmers' purchases of out-of-the-money puts.

Analytical studies of futures-options programs are few. Irwin (1986) used a computer simulation model to compare a subsidized put options program with four other program alternatives for corn. He concluded that "a fully subsidized options program may be an attractive candidate for replacing existing programs," but cautioned that the analysis did not take into account the risk premiums that options writers would likely require and that options programs deal only with short- or intermediate-run price risks.

Rationale for Futures-Options Programs

Programs that expand farmers' direct or indirect use of futures or options markets could perform some of the functions currently performed by Government loans and deficiency payments, but such programs would offer few advantages over conventional programs.

Government costs cannot be lowered by replacing loans or deficiency payments with such programs unless price and income support levels are lowered. Certain types of forward pricing programs might help farmers develop skills needed to manage risks more effectively during an era of lower price supports.

Futures-Options programs are not well-suited for raising or supporting farmers' incomes. Increased futures or options trading alone would not transfer funds from the Government to farmers, raise the price by reducing the quantities of farm products reaching the market, or increase demand.

Features to raise farmers' incomes could be added to a futures-options program. Any futures-options program would require some income transfer or subsidy to attract farmer participation. Significantly raising farmers' incomes would require subsidies beyond those needed merely to persuade farmers to increase use of forward contracts. The additional subsidies might be used partly to reduce quantities produced or marketed. For example, compliance with acreage limitations could be a condition of eligibility for a nationwide futures-options program, as it has been for deficiency payments and nonrecourse loans, and for participation in the 1988-89 futures-options pilot program.

Futures-options programs generally hold more promise for reducing uncertainties about farmers' incomes and Government costs than for raising farmers' incomes. The likely effects of different types of futures-options programs on uncertainty in agriculture are summarized in table 8.

Elsewhere in this report, we show that farmers can reduce intrayear revenue uncertainty by forward pricing in futures, options, or cash forward markets, but the reduction in uncertainty is limited because only prices and not yields are fixed. Farmers' use of these markets may be limited by lack of knowledge and trading skills. These limitations might be partly overcome by additional or expanded educational programs, possibly combined with some subsidies to provide incentives for farmers to develop their forward pricing skills. Such subsidies could be phased out as recipients acquired the needed trading skills.

Government programs could be used to promote specific kinds of risk-management behavior among farmers. Should farmers be encouraged to take certain types of forward positions or encouraged only to learn about forward markets? The first purpose might call for issuing or subsidizing specific types of contracts and controlling their use. The latter purpose would imply purely educational programs, perhaps supplemented with small unrestricted trading subsidies to help farmers get started trading.

Although forward contracts directly reduce current-year income uncertainties, the available contracts do not extend far enough into the future to directly reduce uncertainties about incomes in later years. To substantially reduce the longer term price and income uncertainties generally would require either longer term contracts or Government programs that stabilize prices over years or supplement farmers' incomes in low-price years.

The degree of Government involvement in carryover decisions needs to be resolved before choosing between futures-options programs and other types of programs that affect storage. Can the Government make better interyear storage decisions than private traders? Market imperfections, such as incomplete markets for shifting risk and possibly higher interest rates for private borrowing than for Government borrowing, may result in insufficient private storage. However, it is not clear that private storage is inadequate. Beyond a certain point, removing the interyear variability in agricultural prices through storage becomes extremely costly or impossible. Moreover, recent experience in the cocoa, tin, copper, and coffee markets suggests that buffer stock authorities often are not very adept in stabilizing prices.

Table 8--Likely effects of futures-options programs on uncertainty in agriculture

Type of program	Type of uncertainty reduced		
	Farmers' revenues		Government program costs
	Across years	Within years	
Government trading of existing futures or options contracts:			
To stabilize price	X		
To hedge commitments			X
Issue or support development of long-term contracts for farmers	X		
Support farmer use of existing futures or options contracts		X	<u>1/</u>

X = A reduction in uncertainty.

Blank = No reduction in uncertainty.

1/ Contracting early in the season would be required to reduce Government budgetary uncertainties.

If Government stabilization is deemed desirable, then certain types of futures-options programs could be used to promote stock-carrying and thereby stabilize prices with less direct Government involvement in storage than conventional programs. Existing futures and options contracts are not ideally suited for the task because they are seldom traded more than 12-15 months ahead of maturity, whereas decisions about support levels need to be made 12-24 months in advance of when the crop is marketed.

High levels of skill in forecasting supply and demand and discipline in resisting pressures to raise prices above longrun equilibrium levels are required to successfully operate any Government price stabilization program. The task would be particularly challenging in a program operated through futures or options markets because the Government could not easily overcome mistakes by taking possession of stocks.

Subsidizing Farmers' Use of Forward Contracts

Farmers' use of forward contracts could be subsidized by paying commissions or option premiums, making loans for option premiums or futures margin deposits, or guaranteeing returns by payments at the end of the contract period, as done under the futures-options pilot program for 1988-89. Expanding farmers' use of existing types of contracts would build on previous contracting experience and avoid problems in starting new types of contracts. Since trading decisions would be made by many individuals acting separately, the bunching of trades in short time intervals should be less troublesome than with Government trading, although surges could occur as farmers complied with program deadlines.

Subsidizing farmers' use of forward contracts would be a cumbersome and inefficient way to raise farmers' average incomes. Although such subsidy programs might look like substitutes for price support loans, they would be more like added deficiency payments, since they would not withhold products from the market to raise prices. Deficiency payments would be easier to administer and easier for farmers to use and leave farmers with more flexibility. Of course, virtually any subsidy transfers some income to the recipient. Transfers would be small if the Government only covered commissions or made loans to farmers with forward contracts. Transfers could be relatively large if option premiums or losses on futures or options positions were covered.

Subsidies could provide farmers incentives to try new forward pricing tools. To encourage recommended risk management practices, the subsidies must go not merely for entering contracts but for holding approved forward positions over specified time intervals. Otherwise, the Government could find itself either subsidizing pure speculation or passing out money ineffectually to farmers who qualify for the subsidies and then immediately trade out of their forward positions. Even a requirement for holding forward positions over specified time periods might be circumvented by holding undisclosed opposite positions with a second broker. Thus, the Government's ability to influence farmers' net forward positions through subsidies is limited.

Moreover, the need for and desirability of such Government influence can be questioned. Differences in yield variability, related assets, and risk aversion make it impossible for the Government to determine the best forward position for each farmer. Treating all farmers alike might increase revenue variability for some farmers. These considerations suggest that Government subsidies for forward pricing can do little to promote more effective intrayear risk management by farmers, beyond simply persuading farmers to try forward pricing. A short-lived program aimed at farmers who do not already use forward markets would serve the latter purpose.

Subsidies for farmer contracting could be used like deficiency payments to smooth out yearly variations in farmers' incomes. For example, the Government might pay premiums for put options with the same strike price each year. The farmer's assured price would be constant, but the Government's cost would vary from year to year as the put option premiums varied inversely with the market price.

Subsidies for forward contracting would have only tenuous and indirect effects on interyear storage and price stability. Subsidies for holding put options or short futures positions would provide farmers some motivation to store commodities because price risk would be minimal. But without constraints, farmers might simply hold their offsetting long positions in the futures or options market instead of storing the actual commodity. To obtain the desired effect, specific requirements for stock-carrying would have to be included as a condition for receiving the subsidies. For example, the Government might pay farmers for holding a futures position for a distant delivery date combined with storing the commodity until the futures matured. But then why not simply subsidize the physical storage by itself and let the storer make his or her own decisions about forward contracting?

The Government might reduce the budgetary uncertainty involved in supporting farm prices by paying farmers to trade directly in futures or options markets instead of engaging in trading itself as discussed below. For example, the Government might subsidize put option buying by farmers early in the calendar year. The costs of the program would then be known, regardless of how yields and market prices turn out.

Types of Contracts To Be Subsidized

Forward pricing instruments that are candidates for subsidization include put options, call options, short and long futures positions, and cash forward contracts, possibly including minimum-price contracts. Subsidizing farmers' use of put options would allow participants to gain from price increases and avoid dealing with margin calls (table 9). Options contracts, like futures contracts, are standardized so that the same rules could be easily applied throughout the country. The volume of options trading would have to increase greatly over present levels to

fully substitute for the price guarantees provided by Government loans.

Subsidies for holding call options could help farmers assure themselves of deficiency payments or speculate on price increases. Farmers who have sold their crops can lose from subsequent price rises due to declines in their deficiency payments. This loss can be offset by holding call options, which appreciate in value as prices rise. Subsidizing puts and short futures positions would encourage storage, while subsidizing the holding of calls would encourage farmers to move their products into market channels. If both puts and calls or short and long futures positions were subsidized, these opposing effects on storage would tend to cancel each other out. Subsidizing farmers' use of futures deserves consideration because futures are traded more actively and for more distant delivery dates than options. Subsidizing farmers' use of futures contracts could be complicated by the need to help participants meet margin calls.

Subsidizing cash forward selling may be the most effective way to expand forward pricing in agriculture because farmers already use cash contracts more than futures and options. Determining what contracts qualify for subsidy would be more difficult than with options or futures because each cash forward contract is unique.

Table 9--Advantages of subsidizing different types of contracts

Advantages	Put options	Call options	Futures	Cash forward contracts
Avoids dealing with margin calls	+	+		+
Allows farmer to gain from price rise	+	+		
Already used by many farmers				+
Closely fit each farmers specific needs				+
Already traded in large volume on liquid markets			+	
Standard contracts that are easier to monitor	+	+	+	

+ = An advantage in subsidizing the contract.

Blank = No advantage in subsidizing the contract.

Types of Subsidies

Farmers' use of existing types of contracts could be subsidized by (1) paying fixed amounts per bushel or bale or covering commissions or other trading costs, (2) paying for option premiums, (3) making special loans to provide farmers cash at harvest in lieu of price support loans or to cover margin deposits on futures, or (4) paying farmers at the end of the year the difference between their realized return and the support level. Fixed payments per bushel or bale or to cover commissions and other trading costs for qualifying transactions would be relatively easy to administer. To qualify for payment, farmers could submit copies of purchase and sales statements or monthly reports from commission houses showing time and amount of trades or commissions paid. Copies of cash forward contracts could serve the same function.

The costs of subsidizing commissions would be modest, typically well under 1 percent of the value of the contract, depending upon the commodity.^{8/} Costs of subsidizing interest costs on margin deposits would be of similar magnitude for futures positions held 6-9 months.

The types of contracts allowed could be restricted to encourage risk-shifting instead of pure speculation. For example, the Government might make payments to farmers who either held put options, maintained short futures positions, or held cash forward contracts over specified time intervals. The payment could be fixed for the season or based upon a formula that takes into

^{8/} The commission to buy and sell a futures contract typically runs between \$50 and \$90. Estimates of the commission for standard sized futures contracts as a percentage of the value of the commodity are as follows:

Commodity	Contract size	Assumed price	Commission at \$75 per contract
	<u>Bushels</u>	<u>Dollars per bushel</u>	<u>Percent</u>
Corn	5,000	2.25	0.67
Soybeans	5,000	7.50	.20
Wheat	5,000	3.50	.43
	<u>Pounds</u>	<u>Dollars per pound</u>	<u>Percent</u>
Cotton	50,000	.65	.23

The interest cost for a 10-percent futures margin deposit maintained for 6 months at a 10-percent rate of interest would equal 0.5 percent of the value of the commodity.

account the prices of futures or options. This would encourage farmers to avail themselves of price protection offered in the marketplace but allow flexibility in the type of contract used.

Paying for option premiums would be similar to paying for commissions, except that the payments would be larger. For example, at-the-money options maturing in about 6 months typically trade at premiums equal to 5-10 percent of the futures price. For a put option, this represents the cost of assuring against a price decline. Out-of-the-money puts giving a lower level of price assurance can be purchased for less; in-the-money puts can be purchased for more.

Many farmers rely upon CCC nonrecourse loans at harvest to pay off production expenses. To make a futures-options program as attractive as the traditional nonrecourse loan program, some provision to make cash available at harvest may be needed. This might take the form of an ordinary recourse loan from CCC that would have to be paid back at maturity.

If the program supports trading futures contracts or selling options then the possibility of ensuring farmers loans to meet margin calls should be considered. Otherwise, farmers might be forced out of positions at inopportune times.

Finally, the Government could guarantee a specified level of return for those farmers who enter approved contracts. Shortfalls would be covered by yearend payments. The Food Security Act of 1985 requires that the futures-options pilot program have such guarantees. The availability of a guaranteed return reduces or eliminates the hedging motive for using forward contracts and leaves only the speculative motive. With a guaranteed return, the farmer gains by entering risky contracts since gains are pocketed and losses are absorbed by the Government.

Timing

Designing a subsidized futures-options program involves many decisions about timing. When should contracts be entered? How long should positions be held? Will program participants be allowed to roll one contract over to a contract that expires later?

Whether contracts should be subsidized over the growing season or only after harvest is a key decision. The Government can give growers price assurance early in the year either by subsidizing their entry into forward contracts then or by announcing price levels and conditions for subsidizing contracts later. By getting farmers into forward contracts early in the year, the risks of guaranteeing prices over the growing season could be shifted from the Government to the market. Farmers need to be able to adjust their forward positions over the growing season as yields become more certain. Put options and minimum-price cash forward contracts are conceptually well suited for dealing with the yield risks involved. One problem is that put options with

more distant maturities have not been actively traded in the past. Leaving the contracting until after harvest would be more like the existing loan program. The Government would carry the price risks until the contracts were entered.

As noted previously, a futures-options program would have little effect if participants could qualify for subsidies and then immediately trade out of their positions. However, the chance for participants to adjust to changing market conditions by selling their products and closing out their forward positions earlier than planned should not be denied. Some type of minimum holding period to qualify for payments seems needed. Longer holding periods may be desirable to encourage risk shifting rather than speculation. However, the required holding periods for forward positions should not extend beyond the time when the farmer disposes of the actual commodity.

If farmers are to obtain price assurances starting as early as planting, then they need opportunities to hold forward positions for up to a year or more before delivery. Agricultural options contracts generally have traded actively only 6-8 months before they mature. This seems to imply that rollovers should be allowed as they were with the 1988-89 pilot program. A rollover involves getting out of one contract and replacing it with another contract that matures later. Allowing rollovers makes the program more complex and more difficult to administer. Would farmers be allowed only one rollover or more than one for each crop year? What constraints would apply? Would the Government subsidize commissions for rollovers?

Other Program Provisions

Design of a futures-program involves many other decisions. How many contracts or what proportion of expected or actual output would each participant be allowed? Should coverage be limited to one-half or two-thirds of the expected crop before harvest to not exceed risk-minimizing hedging levels?

The issue is similar but perhaps more complex for options. Here the notion of minimizing revenue risk is difficult or impossible to apply because the probability distributions for revenues are clearly asymmetrical. A one-to-one ratio between puts and expected output seems like an appropriate place to start, but this is not necessarily the best ratio for every farmer.

Subsidies for entering options, futures, or cash forward contracts might be limited to contracts that would be at least marginally advantageous to the farmer without subsidization. This could reflect the objective of helping farmers learn sound trading strategies that apply with and without the program. For example, suppose that the local support price for corn is \$1.80 and the expected basis is 20 cents under, then payments might apply only for options with strike prices of \$2.00 or higher since farmers would be better off to place the commodity under support than to depend on options with lower strike prices.

Under conditions like those occurring in 1987, when generic certificates and/or marketing loans allowed market prices to fall below support levels for some commodities, a put option with a strike price equivalent to the loan rate could be deep in the money and exhibit little, if any, trading activity. How can a program be designed to use the more actively traded options contracts (those near the money) or futures contracts and still attract participants? This may require compensatory payments.

Government Trading of Futures and Options

The Government could buy and sell futures or options contracts for either of two purposes: (1) to stabilize commodity prices without dealing in actual commodities, as Houthakker (1967) proposed, or (2) to reduce budgetary uncertainties involved in supporting farm prices.

The Government cannot effectively raise farmers' incomes by trading futures or options because such trading would not transfer money to farmers or reduce quantities produced. To raise prices by removing the product from the market after it is produced, as was done in the past under price support programs, would require the Government to accept large deliveries and subsequently dispose of surpluses. The social costs of such programs through combined Government expenditures and increased food prices are high. Moreover, futures delivery arrangements are not designed to handle the large volumes that would be involved.

Trading To Reduce Interyear Price Variability

Stabilizing commodity prices over a period of years involves influencing interyear storage. Houthakker (1967) proposed that the Government stabilize prices by buying distant futures during years when supplies were abundant and prices low, rolling these long positions over into later maturing contracts as necessary, and liquidating the positions during years when supplies were smaller and prices higher. By bidding up the price of distant futures during years of large supplies, the Government would enable private storers to benefit from carrying stocks to periods when supplies were smaller. Stock carrying would be discouraged in years when the Government liquidated its futures positions. If managed with skill and with sufficient resources, such a program might overcome a failure of private storers to provide an optimal amount of storage. Government expenditures and receipts for such a program would vary over years, resulting in budgetary uncertainties similar to those with loan and storage programs.

The Government might use options trades instead of futures trades to stabilize prices, if options trading were active enough to provide the necessary liquidity. For example, the Government might sell distant in-the-money put options for relatively low premiums in large crop years, thereby enabling private storers to assure themselves of satisfactory storage returns. The options would expire unexercised if prices rose sufficiently. Otherwise, the options would be bought back before maturity at a net loss to the Government. If further storage were to be encouraged at that

time, the Government could roll over its positions by selling a new set of later maturing put options.

Any program that involves the Government taking or subsidizing positions on only one side of the market would affect stock carrying. For example, subsidizing the holding of put options or short futures positions encourages storage, while subsidizing the holding of calls or long futures positions discourages storage by giving farmers or others another way to speculate on price increases.

For pure stabilization purposes, without raising farmers' incomes on average over a period of years, similar effects might be obtained from Government trading of futures, Government trading of put options, and price support loans. The expected cost over a period of years would be similar under these three alternatives. In general, any program that operates solely to overcome deficiencies in private storage should, on average, be costless or return the Government a profit. The advantage of futures-options programs would be avoidance of Government stock ownership and involvement in cash markets. A major disadvantage is that futures delivery arrangements make it difficult for the Government to extricate itself from ill-advised large positions by taking delivery and disposing of stocks.

A futures or options program operated to reduce interyear price variability would likely encounter problems similar to those that have plagued other stabilization programs. Pressures to raise price levels could lead to increasing Government positions, much as these pressures tend to promote the buildup of Government stocks under the loan program. Effective stabilization with either type of program without accumulating excessively large positions would require skill in forecasting demand and supply and protection from pressures to raise prices above long-term equilibrium levels.

Efforts of the Government to control interyear storage by holding or subsidizing the holding of futures or options positions might fail if private storers thought that the Government could not or would not enforce the higher prices at the end of the storage period. In that case, private traders might simply hold short futures positions or puts instead of storing the commodity. The Government's ability to enforce the higher prices by taking delivery and isolating the stocks from the market would be limited by the inadequacy of futures delivery arrangements for the large volumes involved. Attempts by the Government to take very large deliveries might have effects like a squeeze, driving up prices at the delivery points temporarily, only to have them fall again once the delivery period was over. Alternatively, efforts by the Government to enforce higher prices by rolling over its positions into later maturing contracts might result in large, cumbersome positions overhanging the market and constraining the market's ability to perform its pricing function.

Trading To Reduce Budgetary Uncertainty

The Government could trade futures or options as a hedger to cover the budgetary risks it incurs in guaranteeing farmers' prices. For example, the Government might sell futures or buy put options as price support levels are announced, as the program budget is formulated, or as farmers sign up for the program. These positions would be carried and rolled over as necessary until the time for redeeming loans passed and the Government's price support commitments were fulfilled. If the crop turned out to be large and prices low, the Government could buy back the futures contracts or sell its put options, which would have appreciated in value, to raise money to help cover price support costs. If, instead, the crop turns out to be small and prices high, then price support costs would be small and the Government would either buy back the futures at a loss or let its put options expire unexercised and without value.

Arrangements for the Government to hedge indirectly might be devised if direct Government trading in the futures or options markets were deemed objectionable. For example, the Government might buy special optionlike obligations from dealers using a competitive bidding process, such as that used for marketing Treasury debt instruments. The dealers could, in turn, hedge their commitments in the futures or options markets.

Development of New Types of Contracts for Farmers

Existing futures, options, and cash forward contracts do not meet the needs of all farmers. For example, some farmers would benefit from setting prices more than a year ahead in some cases, and none of the existing types of contracts can provide multiyear price assurance. The Government might help in the development of new types of contracts by supporting research and education, by issuing new types of Government-backed contracts to farmers, or by providing other kinds of support.

Although precious metal futures contracts are traded up to 2 or more years before delivery, agricultural commodity futures generally trade no more than 12-15 months before they mature. This seems to serve adequately the needs of merchants, storers, and processors of agricultural commodities, who apparently do not have enough need for longer term hedging to create an active market in futures with more distant delivery dates. The need for long-term price assurance may be greater for farmers who invest in land and equipment used to produce specific commodities over extended periods. Simply extending the trading periods for existing types of contracts probably is not the solution; new types of contracts may be needed. Evaluating the potential for developing longer term contracts for farm commodities is beyond the scope of this report.

Educational Programs

Any program to increase farmers' use of forward contracts would need an educational component to help participants learn to make

new kinds of pricing and marketing decisions. Purely educational programs are a possibility.

Farmers currently learn about futures and options trading and hedging through a variety of educational programs that offer widely different intensities of training. Many State agricultural extension specialists conduct 2-4 hour meetings at the county level on futures and options. Some private organizations operate schools or seminars offering hedging education at considerable cost to participants. The exchanges and land-grant universities provide educational materials and sometimes seminars to train farmers on the use of futures and options. Intermediaries, such as local cotton merchants and hog producer cooperatives, provide some education for farmers on the use of forward markets. The futures-options pilot program for 1988-89 includes an educational component that provides Extension educators some experience in conducting more intensive educational programs in this area.

Although a variety of educational programs have been offered, relatively few farmers have participated in formal training on the use of futures and options. Extension programs in this area are limited by budget and by the availability of skilled teachers. Farmers may distrust brokers' educational efforts because of the brokers' vested interests. Moreover, farmers may place higher priorities on acquiring other skills, such as how to deal with generic certificates.

A futures-options education program could include funding for developing new educational materials, training Extension personnel on futures and options, or conducting classes for farmers. These educational activities could be implemented through USDA's Extension Service, the Commodity Futures Trading Commission, or jointly by the two agencies.

Education on forward pricing and hedging can be expected to help some farmers improve their management of risks. This may allow them to expand their operations and earn higher average incomes. Education on price forecasting may help some farmers raise average returns directly through more timely selling and buying. However, as noted in a preceding section, farmers as a group cannot expect to achieve significantly higher average incomes solely by improving their price forecasting abilities.

Feasibility and Obstacles to Implementation

Large increases in private holding of long futures positions or granting of put options would be required to carry the agricultural commodity price risks now borne by the Government through farm programs. Figures 12-15 show quantities produced, covered by open futures contracts on all exchanges, and placed under loan for corn, wheat, soybeans, and cotton from 1954 to the present. Quantities covered by open futures contracts have typically ranged from 20 percent to 30 percent of production for soybeans, wheat, and cotton in recent years, and 8 percent to 15 percent of production for corn. However, open futures positions

have been much nearer to the quantities placed under loan and actually exceeded the quantities of soybeans placed under loan.

Either farmers or the Government can obtain substantial reduction in risks by pricing forward much less than total production. Nonetheless, large increases in futures or options open interest would be required for nationwide programs of the types considered here.

Government trading or subsidized farmer trading on the scale needed to provide price guarantees to farmers equivalent to those in current farm programs could pose many problems. It could change the character of the futures and options markets. Government trades would tend to be large and lumpy and could constitute a major proportion of the trades during many time periods. In addition, Government traders would have different motives than commercial traders. The efforts of private traders would be diverted from anticipating demand and supply changes to anticipating Government actions.

Budgetary Effects of Futures-Options Programs

Farm program costs clearly can be lowered by reducing or eliminating price support and deficiency payment programs and letting farmers seek price assurances through the futures and options markets. This would reduce the average incomes of farmers compared with what they would be if current programs were continued. Raising or maintaining farmers' incomes would cost about the same with an options or futures subsidy program as with traditional types of programs.

Costs of Supporting or Stabilizing Farmers' Incomes

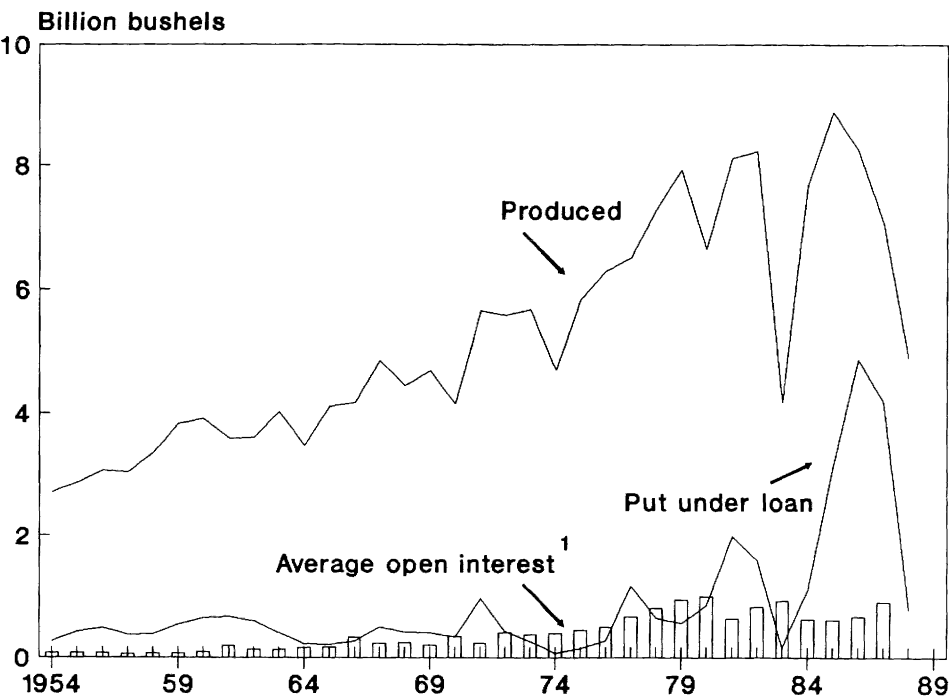
Since an options or futures subsidy is essentially a direct payment with constraints on how the money is spent, the costs of raising farmers incomes above free-market levels would be similar for an options or futures subsidy program as for deficiency payments. Direct Government trading is not suitable for raising farmers' incomes for the reasons previously discussed.

While either Government subsidies for farmer trading of options or futures or direct trading by Government could be used to stabilize farmers' incomes, neither can be expected to result in lower Government costs than traditional storage and deficiency payment programs. Programs to subsidize farmer trading would likely realize higher administrative costs than traditional programs.

Budgetary Uncertainty

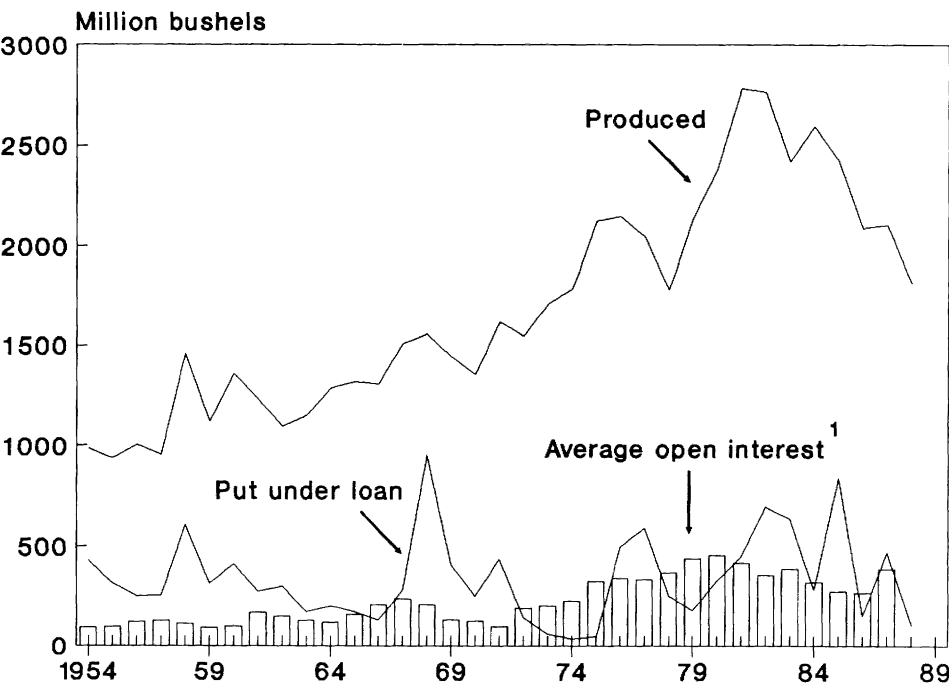
Government trading of futures or options holds some promise for reducing the budgetary uncertainties associated with stabilizing farm incomes. However, the massive transactions that would be required pose many practical difficulties. Moreover, the bulk of

Figure 12
Corn produced, under loan, and in open futures positions, 1954-88



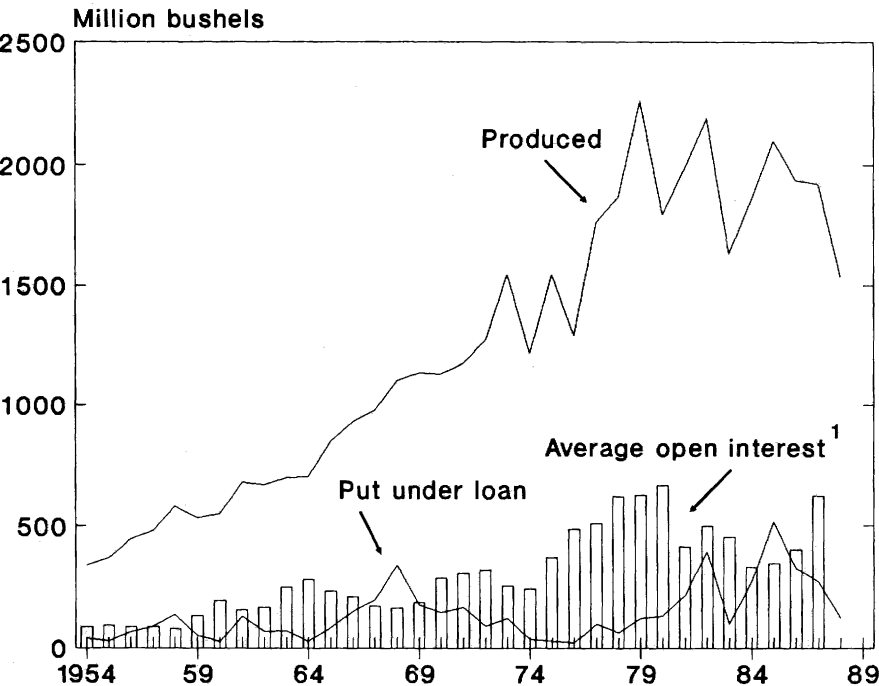
¹October-September 1976-88; July-June prior to 1976.
Source: USDA and Commodity Futures Trading Commission.

Figure 13
Wheat produced, under loan, and in open futures positions, 1954-88



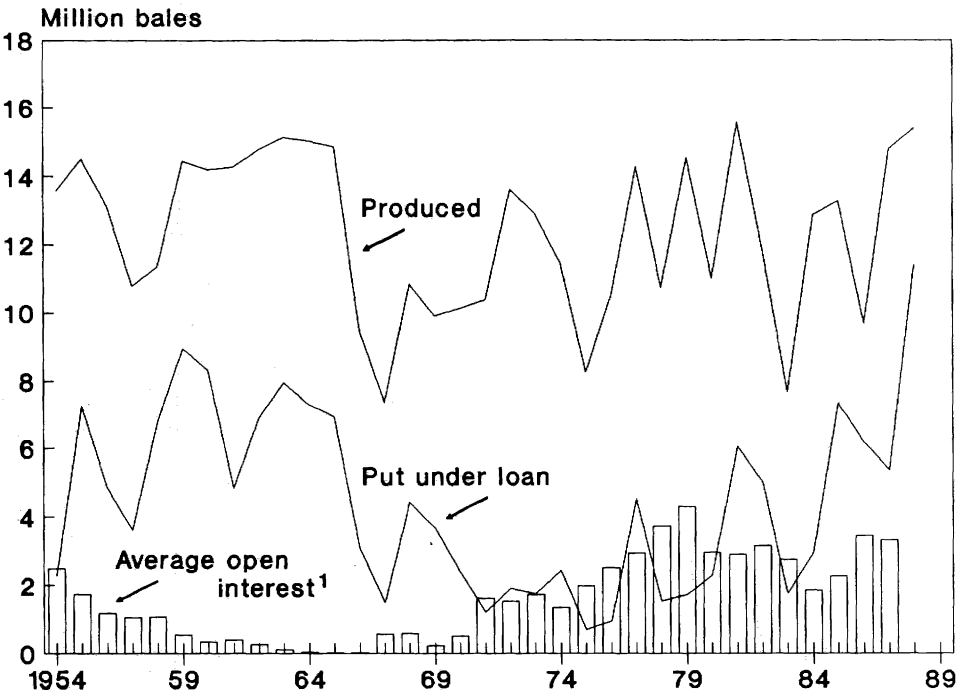
¹October-September 1976-88; July-June prior to 1976.
Source: USDA and Commodity Futures Trading Commission.

Figure 14
Soybeans produced, under loan, and in open futures positions, 1954-88



¹October-September 1976-88; July-June prior to 1976.
Source: USDA and Commodity Futures Trading Commission.

Figure 15
Cotton produced, under loan, and in open futures positions, 1954-88



¹October-September 1976-88; July-June prior to 1976.
Source: USDA and Commodity Futures Trading Commission.

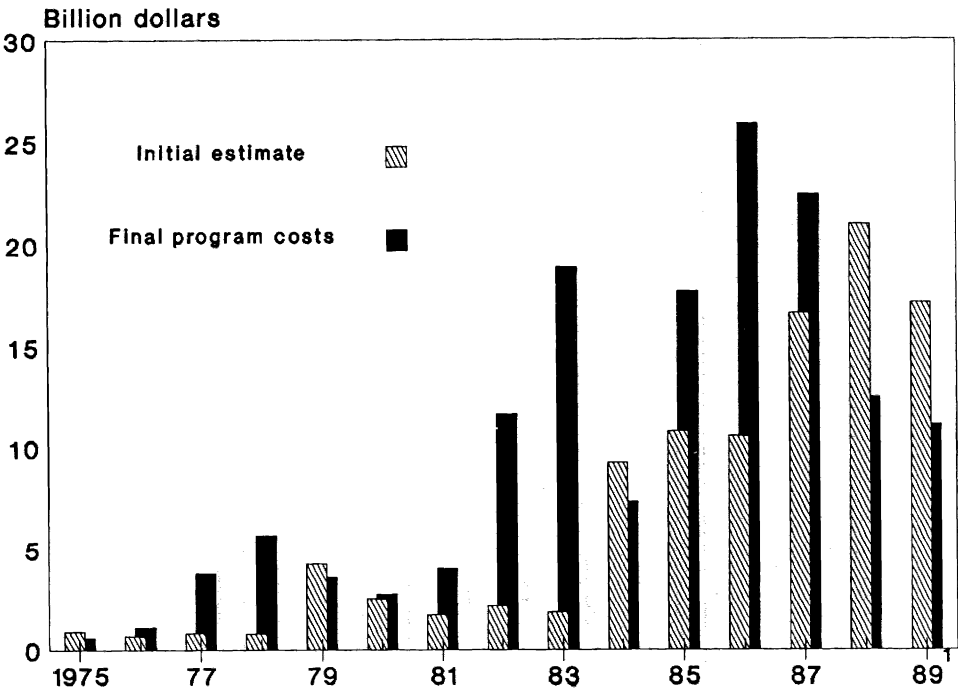
the budgeting errors do not seem to be associated with price changes in a way that allows successful hedging.

Budgetary uncertainty occurs when actual expenditures cannot be predicted precisely as budgets are constructed. The degree of uncertainty is not directly observable and varies from year to year, depending on economic conditions. However, its extent can be gauged by observing historical differences between actual expenditures and estimates of expenditures made earlier.

Federal budgeting begins about 18 months before the fiscal year starts as departments and agencies within the Government prepare their budget recommendations for the administration. A key point in the budgetary process is the submission of the President's budget to Congress in January. Estimated and actual CCC expenditures and total Federal expenditures are shown in figure 16 for fiscal years 1975-89. Corresponding estimated and actual program costs by commodity for feed grains, wheat, soybeans, and cotton are shown in figures 17-20. Both estimated and actual outlays and the differences between them tended to be much larger from 1981 to 1988 than during the seventies.

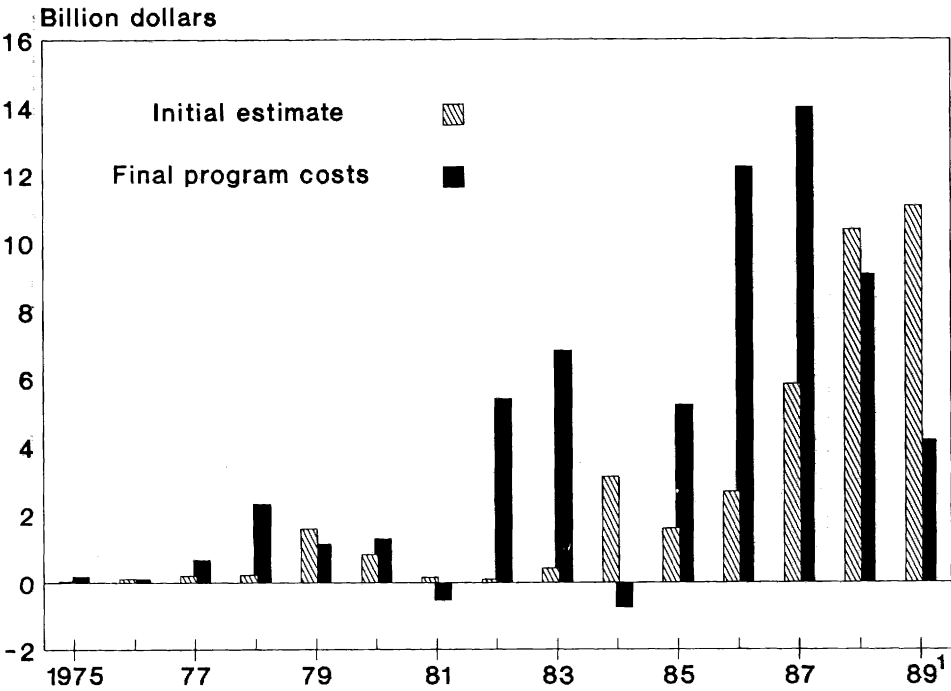
In contrast to a commercial storage operation where price risks begin and end with the storage period, the risks borne by the Government in supporting farm prices are spread over a long and somewhat vaguely defined interval. The timing of the Government's risk exposure is affected by the growing season and the periods allowed for signing up for the program, taking out loans, and determining deficiency payments (fig. 21).

Figure 16
Total CCC program costs, fiscal years 1975-89



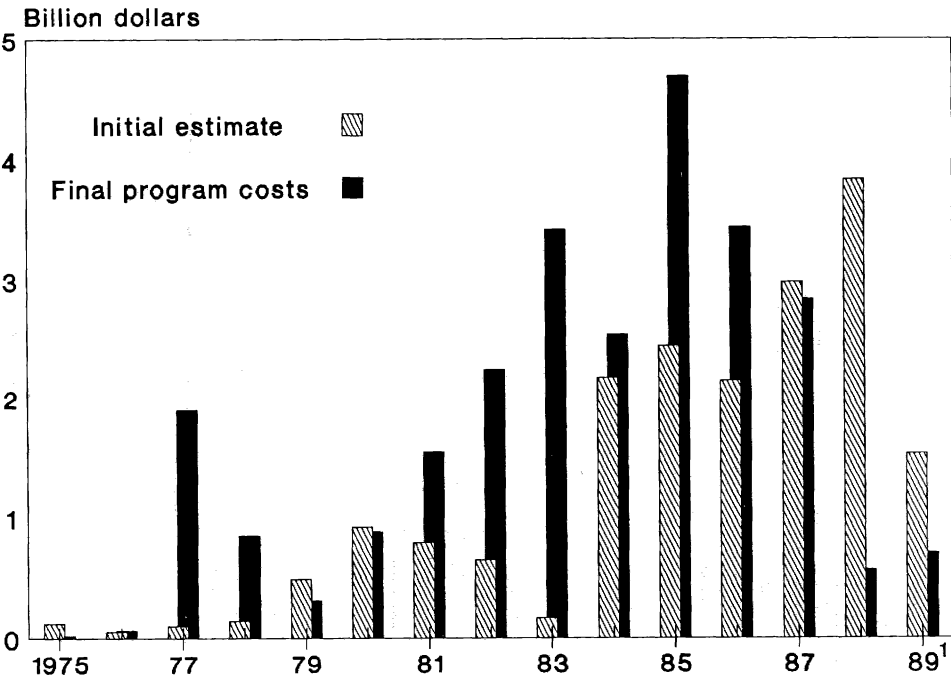
¹Current estimate of final costs.
Source: Office of Budget and Program Analysis, USDA.

Figure 17
CCC feed grain program costs, fiscal years 1975-89



¹Current estimate of final costs.
Source: Office of Budget and Program Analysis, USDA.

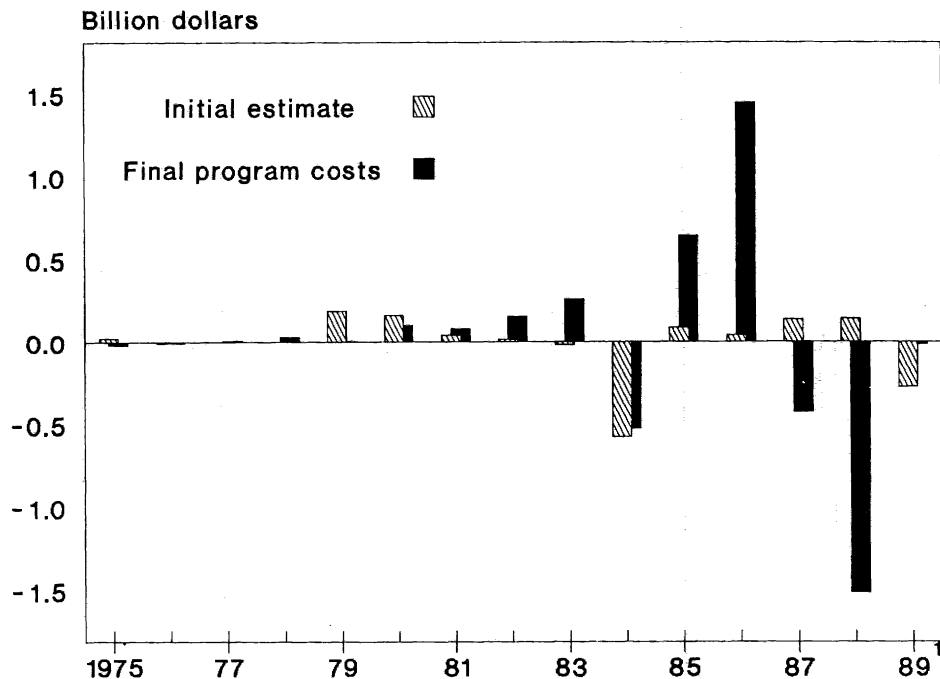
Figure 18
CCC wheat program costs, fiscal years 1975-89



¹Current estimate of final costs.
Source: Office of Budget and Program Analysis, USDA.

Figure 19

CCC soybean program costs, fiscal years 1975-89

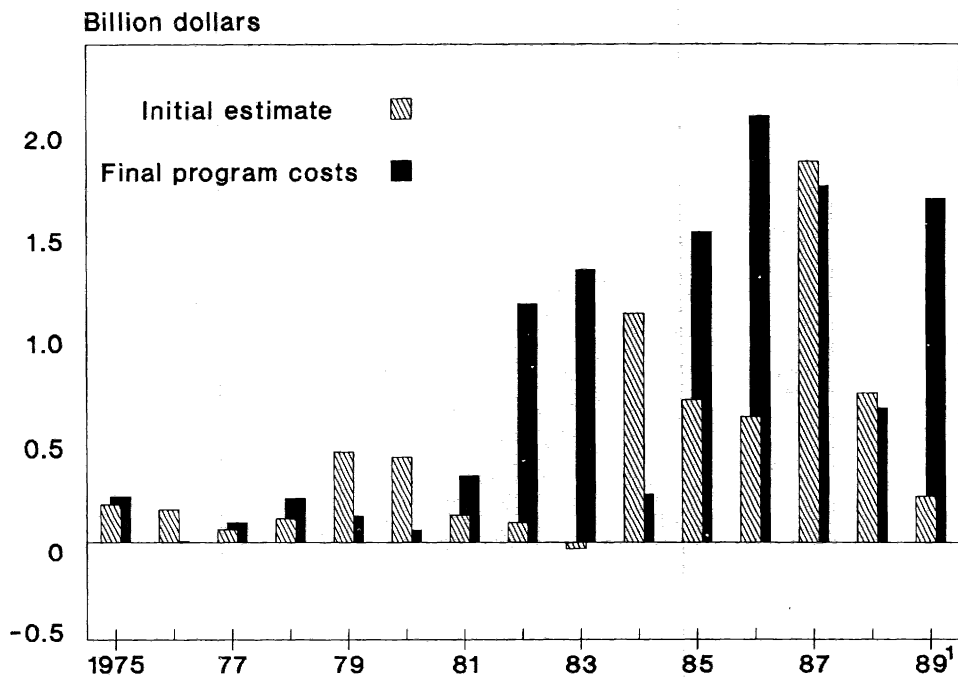


¹Current estimate of final costs.

Source: Office of Budget and Program Analysis, USDA.

Figure 20

CCC cotton program costs, fiscal years 1975-89



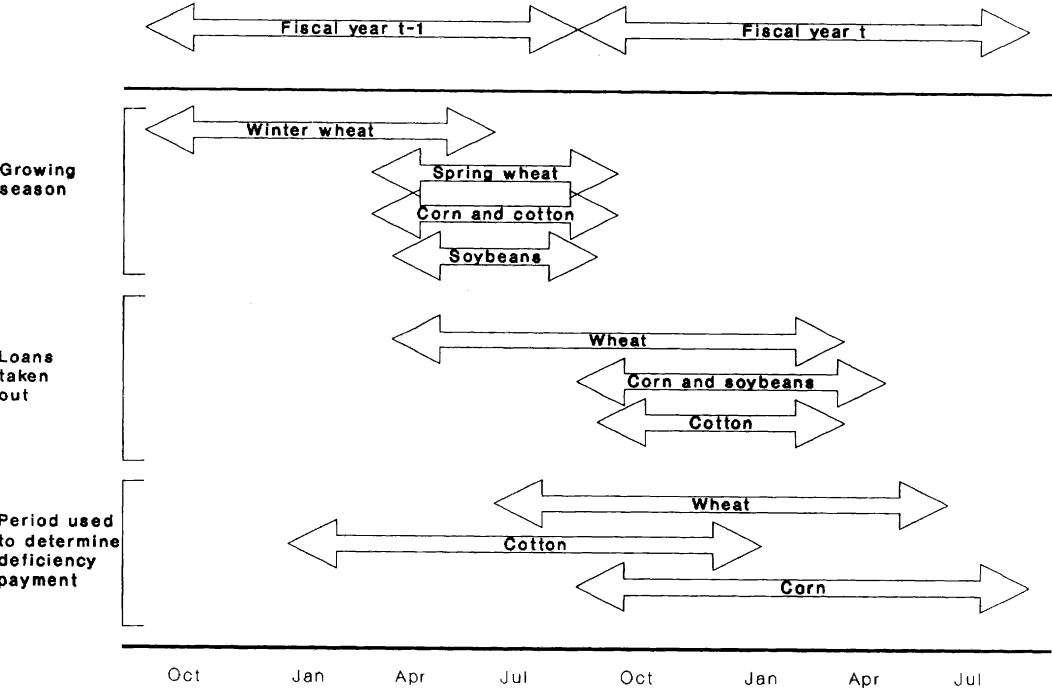
¹Current estimate of final costs.

Source: Office of Budget and Program Analysis, USDA.

We hypothesize that the budgetary risk borne by the Government in supporting the price for a particular year's crop follows a pattern similar to that depicted in figure 22. The enactment of legislation that sets ranges for target prices and loan rates initially makes the Government a grantor of guarantees, similar to put options with vaguely defined strike prices on an unknown quantity of product. Budgetary uncertainty may increase as the Government makes its price and income guarantees more specific while market conditions remain unknown. Budgetary uncertainty decreases as yields, market prices, and farmer participation are established. Budgetary risk rises when price support levels are announced and declines as farmers sign up, as yields are determined, and as farmers take out loans. For a large crop resulting in low market prices, large deficiency payments, and substantial Government takeovers, budgetary uncertainty is higher than for a smaller crop. The Government's budget uncertainties regarding the loan program end if and when the loans are redeemed by farmers. If the farmer forfeits the commodity, the Government's position changes from being, in effect, a grantor of put options to being long in the commodity. Since budgets, which reflect expectations, are developed only a few times each year, we cannot readily verify the seasonal pattern of uncertainty shown in figure 22.

The uncertainties associated with supporting farm incomes are pooled with other uncertainties in the overall Federal budget. Farm program costs have not exceeded 2.6 percent of total Federal outlays in any recent year (table 10). The correlation between actual minus expected expenditures for the CCC budget and total

Figure 21
Calendar for the Government's price risk exposure



Source: Agricultural Stabilization and Conservation Service, USDA.

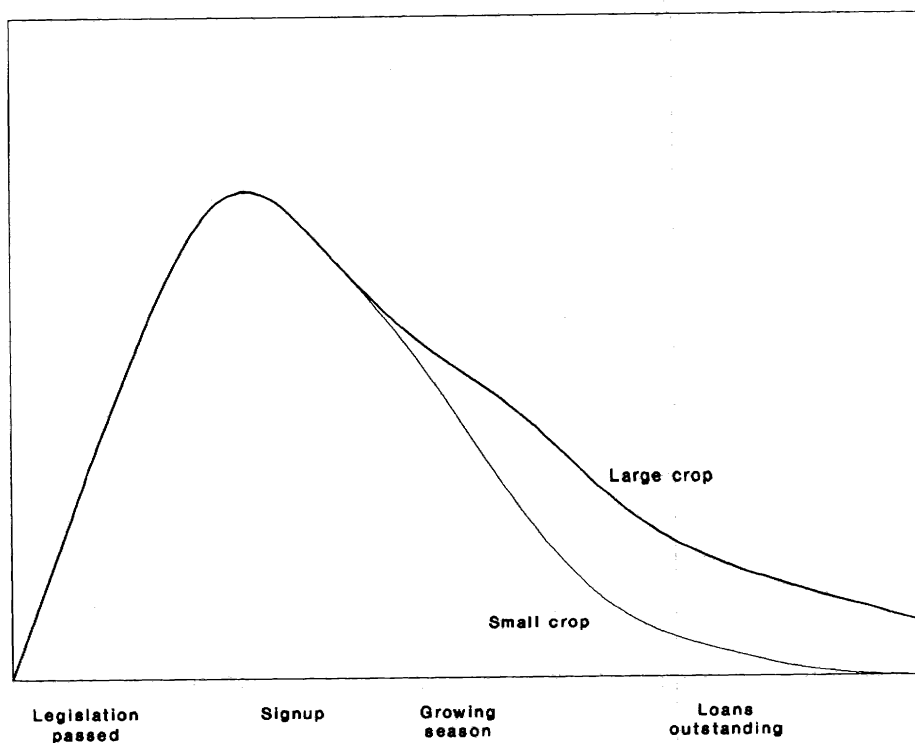
Federal budget was slightly negative (-0.1) for 1980-88, using real dollars. Consequently, completely eliminating CCC budgetary uncertainties would have had relatively little effect on total Federal budgetary uncertainty. Nevertheless, CCC budgeting accuracy is important in making decisions within agriculture.

In guaranteeing support prices or deficiency payments, the Government, in effect, grants put options. To offset the price risks involved, the Government would need to either buy puts or sell futures and hold these positions over periods that correspond to the periods of the price guarantees. Designing a program for the Government to hedge these price commitments is not an easy task. The 1- to 5-year price guarantees embodied in farm legislation clearly cannot be effectively hedged in futures contracts that trade only 12-15 months before maturity. Some new type of contract with longer maturity periods would be needed to hedge such long-term price guarantees.

Prospects for hedging the Government's price commitments over shorter periods are more promising. Suppose that the Government wants to hedge the price commitments embodied in the President's January budget. These budget estimates are for the fiscal year beginning the next October, during which most of the price support costs are realized for crops harvested during that calendar year. The end of the marketing year is at least 16 months away for wheat and 20 months away for the other crops when the January budget estimates are made, but the costs for loans and (regular) deficiency payments are determined before the end

Figure 22

Budget risk borne by the Government in supporting 1 year's crop



of the marketing year.^{9/} Moreover, a major portion of price uncertainties are associated with crop size, which is largely known by July for wheat and by October for the other crops, 6 months and 10 months after the January budget estimates. Thus, the Government might be able to protect the January budget estimates by selling distant futures in January.

If Government budgetary risks are to be shifted through futures or options transactions, then futures or options price changes must be correlated with the differences between actual and budgeted program costs. As a first approximation, we calculated the correlations between actual minus expected outlays for the corn, wheat, cotton, and soybean programs and the returns from holding corresponding short futures positions from January to harvest for fiscal years 1975-88. The simple correlations for these relationships ranged from 0.13 for wheat to 0.51 for corn.

^{9/} Findley deficiency payments are determined at the end of the crop year.

Table 10--Budgeted and actual outlays for Government and CCC programs, fiscal years 1975-88

Fiscal year	Total Government			CCC			CCC share <u>2/</u>
	Budgeted	Actual	Differ- ence <u>1/</u>	Budgeted	Actual	Differ- ence <u>1/</u>	
<hr/>							
	<u>-----Billion dollars-----</u>						<u>Percent</u>
1975	304.4	332.3	27.9	0.9	0.6	-0.3	0.2
1976	349.4	371.8	22.4	.7	1.1	.4	.3
1977	394.2	409.2	15.0	.9	3.8	2.9	.9
1978	440.0	458.7	18.7	.8	5.6	4.8	1.2
1979	500.0	503.5	3.5	4.3	3.6	-.7	.7
1980	531.6	590.9	59.3	2.5	2.7	.2	.4
1981	615.8	678.2	62.4	1.7	4.0	2.3	.6
1982	739.3	745.7	6.4	2.2	11.6	9.4	1.6
1983	757.6	808.3	50.7	1.8	18.8	17.0	2.3
1984	848.5	851.8	3.3	9.2	7.3	-1.9	.9
1985	925.5	946.3	20.8	10.8	17.7	6.9	1.9
1986	973.7	990.3	16.6	10.5	25.8	15.3	2.6
1987	994.0	1,003.8	9.8	16.6	22.4	5.8	2.2
1988	1,024.3	1,064.0	39.7	21.0	13.1	-7.9	1.2

^{1/} Difference is actual outlays minus budgeted outlays. Minus (-) indicates that actual outlays were less than budgeted outlays.

^{2/} Actual CCC outlays as a percentage of actual total Government outlays.

Source: Office of Management and Budget, various issues.

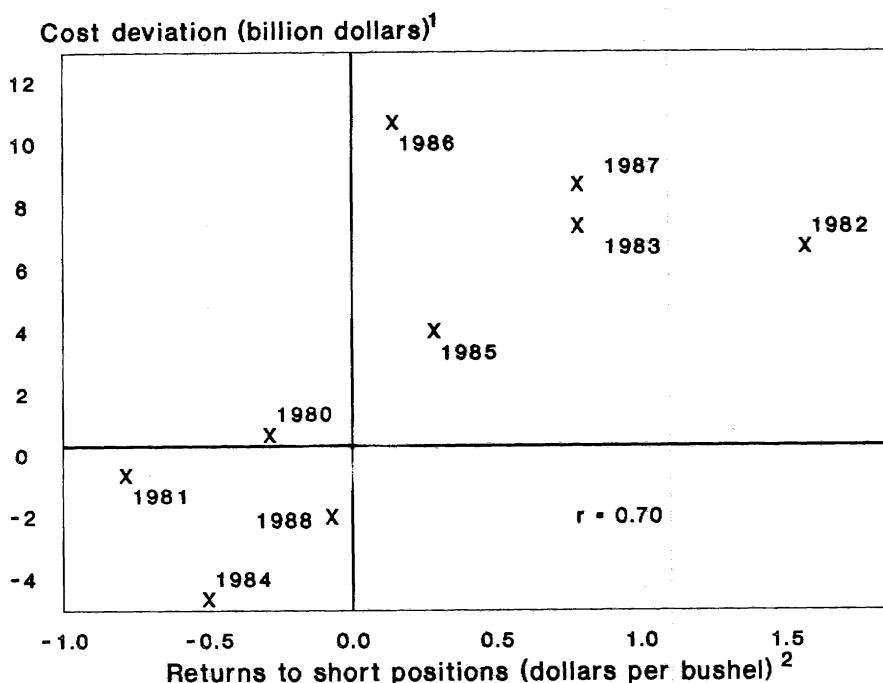
The years from the seventies, which generally reflected relatively small program expenditures and small differences between actual and budgeted program costs, were dropped for the second approximation. The relationships are plotted in figures 23-26 for feed grains (using corn futures), wheat, soybeans, and cotton. The simple correlations range from 0.29 for soybeans to 0.72 for cotton.

The results suggest that up to 50 percent of the errors in estimating program costs might have been eliminated by shifting price risks to the marketplace for corn, 30-40 percent for wheat, and less than 10 percent for soybeans. The sizes of the Government short futures positions that would have minimized the variance of budget overruns were estimated by regressing budget overruns on the returns from the short futures positions (table 11). The resulting estimates of minimum-variance hedging levels are 5.0, 1.2, and 0.2 billion bushels for corn, wheat, and soybeans and 8.9 billion bales of cotton.

These estimates show that uncertainty about CCC budgets might have been reduced through hedging during 1980-88 to the extent that the futures markets could have absorbed the trades without distorting prices. To minimize budgetary uncertainty Government short positions would have to be very large, although considerable reduction in uncertainty would be possible with smaller positions. Whether sufficient long private speculation could be developed to carry these large positions is an important question. Such large-scale Government trading could lead to many

Figure 23

Corn program cost deviations related to returns on short positions, fiscal years 1980-88

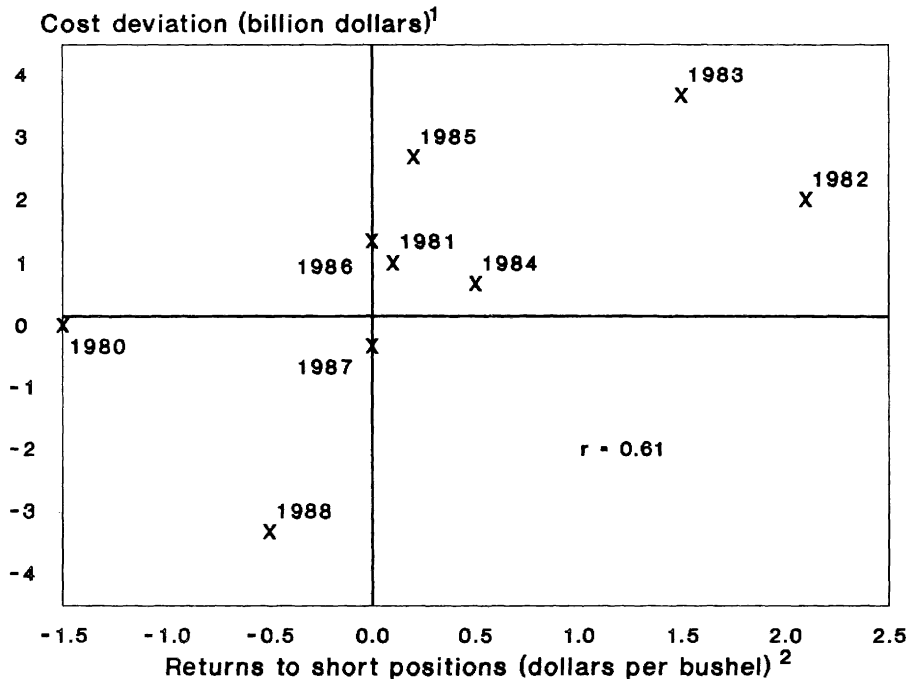


¹Actual costs minus estimated costs (1988 dollars).

²Short position in December corn futures held from January 15 to December 15 (1988 dollars).

Figure 24

Wheat program cost deviations related to returns on short positions, fiscal years 1980-88

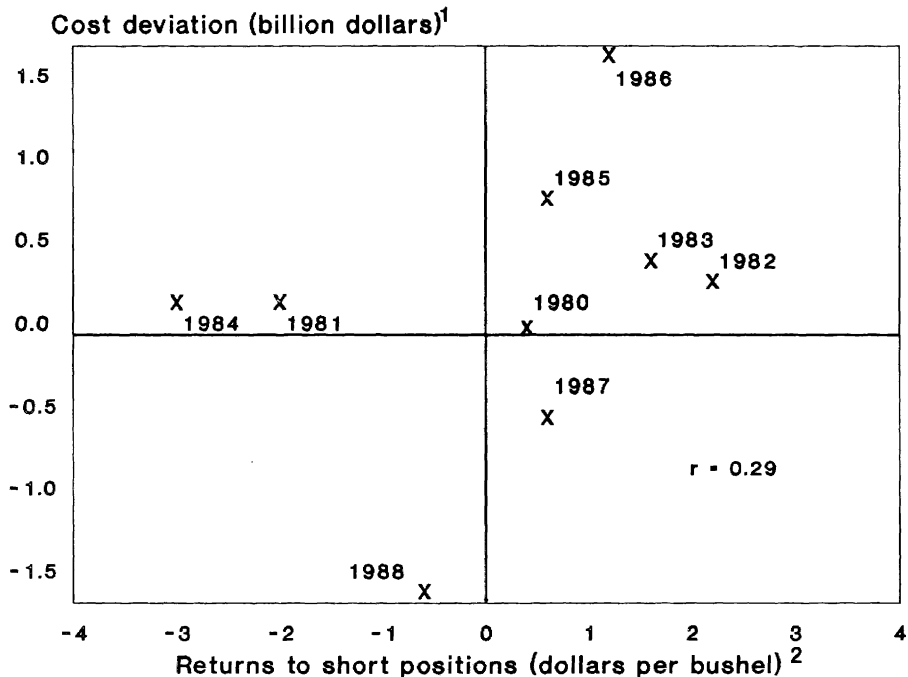


¹Actual costs minus estimated costs (1988 dollars).

²Short position in December Chicago wheat futures held from January 15 to December 15 (1988 dollars).

Figure 25

Soybean program cost deviations related to returns on short positions, fiscal years 1980-88



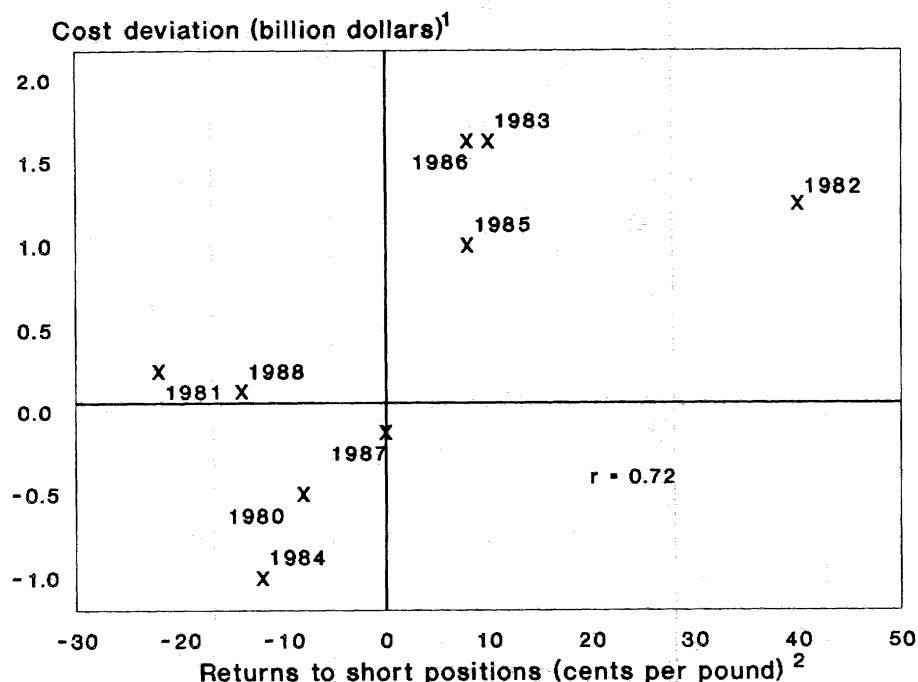
¹Actual costs minus estimated costs (1988 dollars).

²Short position in November soybean futures held from January 15 to October 15 (1988 dollars).

problems, as noted previously. The need for and effects of Government hedging will probably be less in the future, with price supports lower relative to market-clearing prices.

Figure 26

Cotton program cost deviations related to returns on short positions, fiscal years 1980-88



¹Actual costs minus estimated costs (1988 dollars).

²Short position in December cotton futures held from January 15 to October 15 (1988 dollars).

Table 11--Regression estimates of minimum-variance Government hedges, 1980-88 ^{1/}

Commodity	Constant	Regression coefficient	R ₂
Corn	2.290	4.9620 (1.8850)	0.50
Wheat	.520	1.1550 (.567)	.37
Cotton	.450	.0427 (.0157)	.51
Soybeans	.050	.1470 (.1830)	.08

^{1/} Dependent variables are actual costs minus budgeted program costs in billions of dollars. Independent variables are returns on short futures positions held from January 15 until harvest in dollars per bushel for the grains and soybeans and cents per pound for cotton. All data are in 1988 dollars. Standard errors are shown in parentheses.

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Glossary

Basis. Difference between a specific futures price and a specific cash price for the same or related commodity.

Bias. Difference at a point in time between a futures price and the spot price that is then generally expected to prevail when the futures contract matures.

Call option. The right, without obligation, to buy a futures contract at a specified price during a specified time period.

Cash forward contract. A forward contract entered outside the rules of an organized futures exchange.

Deferred pricing. Cash forward contracting that provides for determining price by formula at a later date. When the formula sets price relative to a futures price, it is called "booking the basis" in the grain trade and "call pricing" in the cotton trade.

Deficiency payment. A payment from the Government to a farmer equal to the difference between the target price and the greater of the market price or the loan rate.

Delayed pricing. A type of deferred pricing that provides for transfer of title before the price is determined and final settlement made. Contracts including this feature are sometimes called "price-later" contracts.

Exercise. The act of a commodity option holder to convert an option contract into a futures contract.

Expectation. An individual's best estimate at a point in time of the mean of the distribution of a random variable.

Fixed-price contract. A forward contract that sets the specific price to be paid by the buyer to the seller.

Formula pricing. Entering a forward contract that contains rules for setting price at a later date, usually in terms of a specified discount or premium relative to a market price to be observed at the later date.

Forward contract. An agreement between two parties calling for delivery of a product and payment at a future date. The agreement sets quantity, grade, time and place of delivery, and either sets price, sets a minimum or maximum price, or provides a formula for determining the price.

Forward market. An institutional arrangement for entering into forward contracts.

Forward pricing. Reaching an agreement between the seller and buyer on a price, or a minimum or maximum price, for a future delivery.

Futures trading. Buying and selling standardized fixed-price forward contracts under the rules of an organized exchange.

Futures-options program. A Government program designed to expand direct or indirect farmers' use of commodity futures or options markets.

Hedge. To enter a commodity futures or options position opposite to a cash position as a means of reducing exposure to price variation.

In-the-money option. An option contract that would yield a positive return to the holder if exercised. An option is in-the-money if the strike price exceeds the market price for a put or is less than the market price for a call. The magnitude of this difference is the intrinsic value of the option.

Intrinsic value. The amount that would be realized by immediately exercising an option and trading out of the resulting futures position. The intrinsic value is positive for an in-the-money option and zero otherwise.

Liquidity. The ease of realizing an asset's underlying value in a market. High liquidity requires ready access to other willing traders and low transactions costs.

Long position. Ownership of a commodity or resources committed to producing a commodity or the holding of a contract to buy a commodity at a set or limited price.

Margin. A deposit made by a futures trader with a commodity brokerage firm or by a clearinghouse member with the

clearinghouse of an exchange to assure compliance with contract terms. The initial margin is the amount required to enter a futures position; the maintenance margin is the amount required to continue a futures position without receiving a margin call.

Margin call. A request from a brokerage firm to a customer or from an exchange clearinghouse to a clearinghouse member for additional margin to cover the customer's futures position after a price change unfavorable to the customer.

Minimum-price contract. A cash forward contract that guarantees a specified price to the seller, allows for a higher price under certain conditions, and requires delivery.

Option contract. A contract that gives the holder the right, but not the obligation, to buy or sell at a specified price, particularly a standardized commodity options contract traded on an exchange.

Out-of-the-money option. An option contract that cannot be profitably exercised at the current market price. An option is out of the money if the market price exceeds the strike price for a put or is less than the strike price for a call.

Premium. The price paid by an option buyer to the option seller for an option contract.

Put option. The right, without obligation, to sell a futures contract at a specified price during a specified time period.

Risk aversion. Preference for a certain outcome over an uncertain outcome with equal expected value.

Risk premium. A return paid or earned for bearing risk.

Risky. Subject to randomness in outcomes that are not equally desirable to the decisionmaker.

Routine hedging. Hedging according to standard rules without attempting to anticipate changes in the futures price.

Selective hedging or discretionary hedging. Hedging that takes into account anticipated changes in the futures price.

Short position. The holding of a contract to sell a commodity at a set or minimum price.

Speculation. Holding a net long or short position in a commodity to profit from anticipated price change.

Spot delivery. Immediate delivery or delivery within the shortest time interval normally allowed in the trade to accommodate merchandising requirements, typically 1 day, 10 days, or within the month for agricultural commodities.

Strike price. The price at which the holder of an option contract can exercise the option.

Uncertainty. Lack of predictability because of randomness or incomplete information.

Writer or grantor. A person who sells an option.

Appendix I: Sections 1741-1743 of the Food Security Act of 1985

Sec. 1741 (a). Congress finds that there is a need for investigation and development of alternative price support programs carried out by the Department of Agriculture; that agricultural producers and others have insufficient knowledge concerning the nature and extent of price stabilization available in the private sector; and that more information is needed to accurately assess the Federal budgetary impact of producer participation in such private sector risk avoidance services.

(b). It is declared to be the policy of the United States that the Department of Agriculture conduct economic research to develop more information concerning the manner in which producers might utilize agricultural commodity futures markets and options markets in connection with their marketing of the agricultural commodities of their own production; and to determine the nature and effect widespread utilization of such markets by producers would have on the prices they receive for their agricultural commodities, and to determine the feasibility of interfacing traditional Federal price support programs with private sector risk avoidance services.

Study By the U.S. Department of Agriculture

Sec. 1742. The Secretary of Agriculture shall conduct a study utilizing the services of the various agencies of the United States, including, but not limited to, the United States Department of Agriculture and the Commodity Futures Trading Commission, to determine the manner in which agricultural commodity futures markets and agricultural commodity options markets might be used by producers of agricultural commodities traded on such markets to provide such producers with price stability and income protection; the extent of the price stability and income protection producers might reasonably expect to receive from such participation; and of the Federal budgetary impact of such participation compared with the cost of the applicable established price support programs for agricultural commodities. The Secretary shall report the results of such a study to the Committee on Agriculture, Nutrition and Forestry of the Senate and to the Committee on Agriculture of the House of Representatives on or before December 31, 1988.

Pilot Program

Sec. 1743. In connection with the study to be undertaken by the Secretary as required by section 1742 of this subtitle, the

Secretary shall conduct a pilot program with respect to the crops of wheat, feed grains, soybeans, and cotton in at least 40 counties which actively produce reasonable quantities of such major agricultural commodities traded on the commodity futures markets and the commodity options markets. The Secretary shall, in cooperation with the futures and options industry and the Chairman of the Commodity Futures Trading Commission, conduct an extensive educational program for producers in the counties selected for the pilot program. The program shall, among other things, provide that a reasonable number of producers, as determined by the Secretary, may at their election and in accordance with pilot program requirements developed by the Secretary, participate in the trading of designated agricultural commodities on a futures market or options market in a manner designed to protect and maximize the return on agricultural commodities of their own production marketed by them in accordance with program requirements. Participating producers shall be assured by the Secretary under the terms of the program, using funds of the Commodity Credit Corporation, that the net return received for the agricultural commodities that such producers allocate to the program in the manner specified by the Secretary is no less than the price support loan level for such agricultural commodity in the county where it is produced. In the formulation of the pilot program the Secretary shall utilize the services of an advisory panel selected by the Secretary consisting of producers, processors, exporters, and futures and options traders on organized futures exchanges.

Appendix II: Method for Estimating the Risk-Reducing Effectiveness of Routine Forward Pricing

The risk-reducing effectiveness of forward pricing (z) is measured as the proportional reduction in revenue uncertainty obtained by hedging or pricing forward:

$$(1) \quad z = 1 - s_h/s_u,$$

where s_h and s_u are standard deviations of differences (D_h and D_u) between expected revenues and realized revenues with and without forward pricing 50 percent of the expected crop at planting. Yield and harvesttime price of output are sources of uncertainty in gross revenues. Input costs are an additional source of uncertainty about future-year net revenues. We assume that input costs are known in formulating expectations about current-year revenues because crop growers typically purchase inputs before planting. Basis risk is omitted in this analysis.

Estimates are based on 1960-88 State yields, midmonth closing futures prices at planting and harvest for futures contracts maturing at harvest, and indexes of prices paid by farmers for seed, fertilizer, chemicals, and fuel (USDA, Agricultural Prices). Yields were detrended and adjusted to 1988 levels. Futures prices and indexes of prices paid for inputs were deflated with the implicit gross national product (GNP) deflator (1988 = 1).

Gross revenue for each year without forward pricing (G_u) equals adjusted yield times the harvesttime futures price adjusted for basis.

$$(2) G_u = Y(F_{11} + b),$$

where capital letters represent annual observations with the time subscript omitted, Y is the State average yield adjusted for trend, F_{11} is the price of the maturing futures contract at harvest, and b is the estimated harvesttime basis (app. table 1).

Gross return with forward pricing equals gross return without forward pricing plus the gain or loss on the futures position.

$$(3) G_h = G_u + hy(F_{01} - F_{11}),$$

where h is the proportion sold forward (0.5 for this analysis), y is the base yield (app. table 1), and F_{01} is the planting time

Appendix table 1--Coefficients used in analysis

Commodity and State	Base yield <u>1/</u>	Harvest- time basis <u>2/</u>
	<u>Bushels per acre</u>	<u>Cents per bushel</u>
Corn:		
Iowa	124.9	-50
North Carolina	85.1	4
Ohio	116.6	-36
Soybeans:		
Arkansas	24.1	-18
Georgia	24.9	-49
Illinois	37.3	-30
Winter wheat:		
Kansas	33.6	-50
Texas	21.1	-44
	<u>Pounds per acre</u>	<u>Cents per pound</u>
Cotton:		
Alabama	566	-7.4
Arizona	1261	-4.5

1/ Levels projected for 1988 using least squares trends fitted for 1949-88 (1960-88 for wheat).

2/ November basis for corn, soybeans, and cotton and June basis for winter wheat estimated by averaging prices paid to farmers by State minus midmonth closing futures prices over 1979-88 in 1988 dollars.

price for the futures contract that matures at harvest. Net revenues unhedged and hedged (N_u and N_h) are:

$$(4) N_u = G_u - C,$$

$$(5) N_h = G_h - C,$$

where C is the cost of purchased inputs per acre.

To approximate the costs of purchased inputs, cost estimates for 1988 derived from the Economic Research Service's cost of production surveys (app. table 2) were multiplied by the corresponding deflated indexes of prices paid with 1988 = 1.

$$(6) C' = sP_s + fP_f + hP_h + pP_p + v,$$

where C' is the cost of inputs per acre in 1988 dollars; s , f , h , p , and v are estimated costs per acre in 1988 for seed, fertilizer, chemicals, fuel, and other variable inputs, respectively; and P_s , P_f , P_h , and P_p are corresponding deflated

Appendix table 2--Cost estimates used in analysis

Commodity and State	Estimated 1988 cost per acre <u>1/</u>				
	Seed	Fertilizer	Chemicals	Fuel	Other
<u>-----Dollars per acre-----</u>					
Corn:					
Iowa	19.78	49.56	22.60	10.16	27.48
North Carolina	18.35	63.78	22.69	9.78	34.11
Ohio	21.00	63.97	20.89	10.47	30.62
Soybeans:					
Arkansas	9.61	3.95	12.88	8.62	16.31
Georgia	10.03	15.48	27.25	9.44	23.27
Illinois	11.74	5.83	19.31	7.68	13.32
Winter wheat:					
Kansas	6.16	17.71	1.60	6.40	17.06
Texas	6.32	14.37	4.16	8.49	14.08
<u>-----Dollars per acre-----</u>					
Cotton:					
Alabama	8.38	40.59	110.42	16.30	115.12
Arizona	9.22	59.13	105.86	145.52	317.02

1/ Calculated by converting estimates in Davenport (1988), McElroy (1986, 1987), and McElroy, Dismukes, and Ali (1989), to 1988 dollars and averaging for 1984-87.

indexes of prices paid for inputs (1988 = 1). Input costs were increased by interest over the growing period.

$$(7) C = [(1 + Im/12)/100]C',$$

where I is the prime rate of interest and m is the length of the growing period in months.

Because we assume that longrun expected revenue equals average revenue the standard deviations of G_u and G_h , serve as s_u and s_h for gross revenues in the long run. Similarly, the standard deviations of N_u and N_h serve as s_u and s_h for net revenues in the long run.

Expected gross revenue per acre in the current year (E) is:

$$(8) E = y(F_{01} + b).$$

The resulting expressions for differences between realized and expected current-year gross revenues unhedged and hedged (D_u and D_h) are:

$$(9) D_u = G_u - E,$$

$$(10) D_h = G_h - E.$$

Equations (9) and (10) also represent the differences between realized and expected current-year net revenues because input costs cancel out of the expressions.

Appendix III: Equivalences in Price Risk Exposure Between Combinations of Contracts

Options contracts decompose risks and redistribute them among traders in ways not possible with futures alone. By adding vertically the functions in figure 9 we can confirm that each futures position is equivalent in price risk exposure to a combination of two at-the-money options positions as follows:

$$(11) \text{ Long futures} = \text{Hold call option} + \text{Grant put option},$$

$$(12) \text{ Short futures} = \text{Hold put option} + \text{Grant call option}.$$

Price risk exposure for a farmer who is eligible for a price support loan is similar to price risk exposure for a farmer holding a put option with a strike price equal to the support price. Both the support price and the put option guarantee a minimum price and allow the farmer to sell for a higher price, if a higher price occurs within a specified time period. However, the farmer's price risk exposure is not identical in the two cases. Options cover a fixed quantity, while price supports cover all that is produced on the qualifying farm. Moreover, price support programs normally provide for the Government to release stocks when the market price exceeds a designated release price. This places an upper limit on the producer's price, in effect causing

the farmer to grant a call option at the release price in combination with holding a put option at the loan rate.

$$(13) \quad \begin{array}{l} \text{Price} \\ \text{support} \\ \text{eligibility} \end{array} \approx \begin{array}{l} \text{Hold put option at loan rate} \\ + \\ \text{Grant call option at release price.} \end{array}$$

Granting a call option at the release price involves little price risk exposure if the release price is well above the market price or the Government has few stocks to release.

Deficiency payment eligibility also is approximately equivalent to holding options positions during part of the season. Deficiency payments equal the difference between a target price and the market price or the loan rate, whichever is higher. The market price is taken as an average of prices observed during the first half or two-thirds of the marketing year. Thus, increases in the market price above the loan rate result in smaller deficiency payments. If the market price used for determining the deficiency payment were for a particular date instead of an average over time, then prior to that date the equivalence would be as follows:

$$(14) \quad \begin{array}{l} \text{Deficiency} \\ \text{payment} \\ \text{eligibility} \end{array} \approx \begin{array}{l} \text{Hold put option at target price} \\ + \\ \text{Grant put option at loan rate,} \end{array}$$

where both options mature on the date when the deficiency payment is determined. The deficiency payment is zero when the market price exceeds the target price and is constant when the market price lies below the loan rate. Thus, once a crop is sold, the farmer can hedge uncertainty about the deficiency payment by holding a put option at the target price (which could be partly financed by granting a put option at the loan rate).

By adding the preceding two equations, we can show that during this same time interval, combined eligibility for the loan and the deficiency payment gives the following:

$$(15) \quad \begin{array}{l} \text{Loan eligibility} \\ + \\ \text{Deficiency payment} \\ \text{eligibility} \end{array} \approx \begin{array}{l} \text{Hold put option at} \\ \text{target price} \\ + \\ \text{Grant call option at} \\ \text{release price.} \end{array}$$

Again, we must keep in mind that the equivalences shown in equations (13)-(15) are only approximate because deficiency payments are based on season average prices instead of current market prices and because price supports generally apply to all that the farmer produces while options apply to a fixed quantity determined in advance.